Utilities → Terminal, and then type or copy exactly the following and press return:

```
mkfile 1g ~/Desktop/BigFile.txt
```

This makes a 1GB file that you can duplicate until macOS feels the pressure.

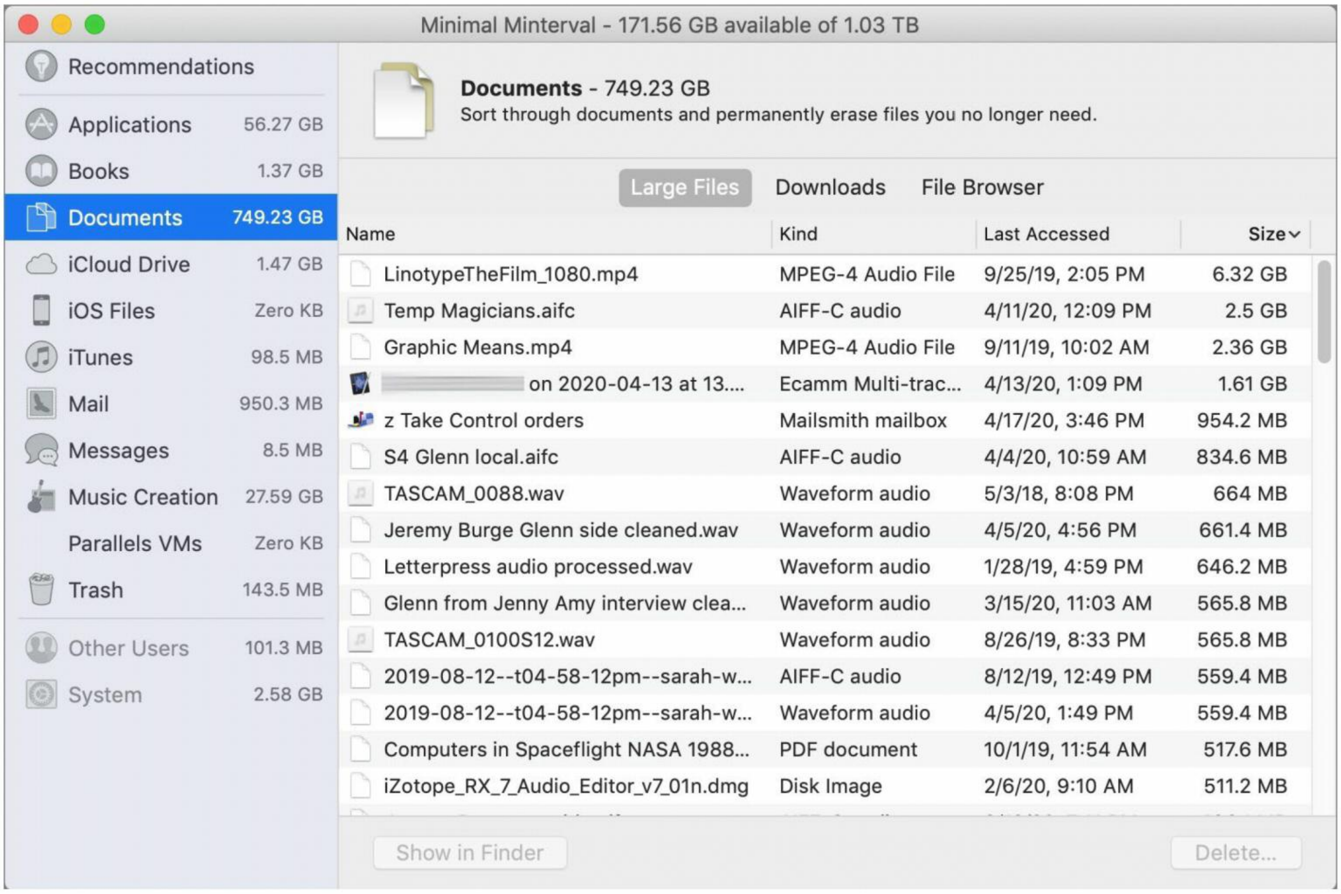
You can check whether material was removed for iCloud storage in several ways:

> In the Finder, make sure View → Show Status Bar, which will show the currently available storage at the bottom of any window showing a folder within the startup drive.

> Select the startup drive in the Finder and choose File → Get Info. macOS shows in the Used section how much is occupied as files are deleted.

> Choose → About This Mac and then click the Storage button and click Manage. This few shows a number of suggestions for deleting files and applications altogether, but can also track how much The Recommendations assistant appears in System Information, offering a variety of ideas about reducing storage.

When consumed storage on your current Mac drops significantly below the size limited of your new drive, you can delete those large files and empty the trash, and then proceed on your migration. ■



Minimal Minterval - 171.56 GB available of 1.03 TB

Recommendations	
Applications	56.27 GB
Books	1.37 GB
Documents	749.23 GB
iCloud Drive	1.47 GB
iOS Files	Zero KB
iTunes	98.5 MB
Mail	950.3 MB
Messages	8.5 MB
Music Creation	27.59 GB
Parallels VMs	Zero KB
Trash	143.5 MB
Other Users	101.3 MB
System	2.58 GB

Documents - 749.23 GB

Sort through documents and permanently erase files you no longer need.

Name	Kind	Last Accessed	Size
LinotypeTheFilm_1080.mp4	MPEG-4 Audio File	9/25/19, 2:05 PM	6.32 GB
Temp Magicians.aifc	AIFF-C audio	4/11/20, 12:09 PM	2.5 GB
Graphic Means.mp4	MPEG-4 Audio File	9/11/19, 10:02 AM	2.36 GB
[redacted] on 2020-04-13 at 13....	Ecamm Multi-trac...	4/13/20, 1:09 PM	1.61 GB
z Take Control orders	Mailsmith mailbox	4/17/20, 3:46 PM	954.2 MB
S4 Glenn local.aifc	AIFF-C audio	4/4/20, 10:59 AM	834.6 MB
TASCAM_0088.wav	Waveform audio	5/3/18, 8:08 PM	664 MB
Jeremy Burge Glenn side cleaned.wav	Waveform audio	4/5/20, 4:56 PM	661.4 MB
Letterpress audio processed.wav	Waveform audio	1/28/19, 4:59 PM	646.2 MB
Glenn from Jenny Amy interview clea...	Waveform audio	3/15/20, 11:03 AM	565.8 MB
TASCAM_0100S12.wav	Waveform audio	8/26/19, 8:33 PM	565.8 MB
2019-08-12--t04-58-12pm--sarah-w...	AIFF-C audio	8/12/19, 12:49 PM	559.4 MB
2019-08-12--t04-58-12pm--sarah-w...	Waveform audio	4/5/20, 1:49 PM	559.4 MB
Computers in Spaceflight NASA 1988...	PDF document	10/1/19, 11:54 AM	517.6 MB
iZotope_RX_7_Audio_Editor_v7_01n.dmg	Disk Image	2/6/20, 9:10 AM	511.2 MB

System Information offers an assistant to help you find files and apps to remove.

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iPHONE 12 PRO MAX REVIEW

Macworld

JANUARY 2021

FROM IDG

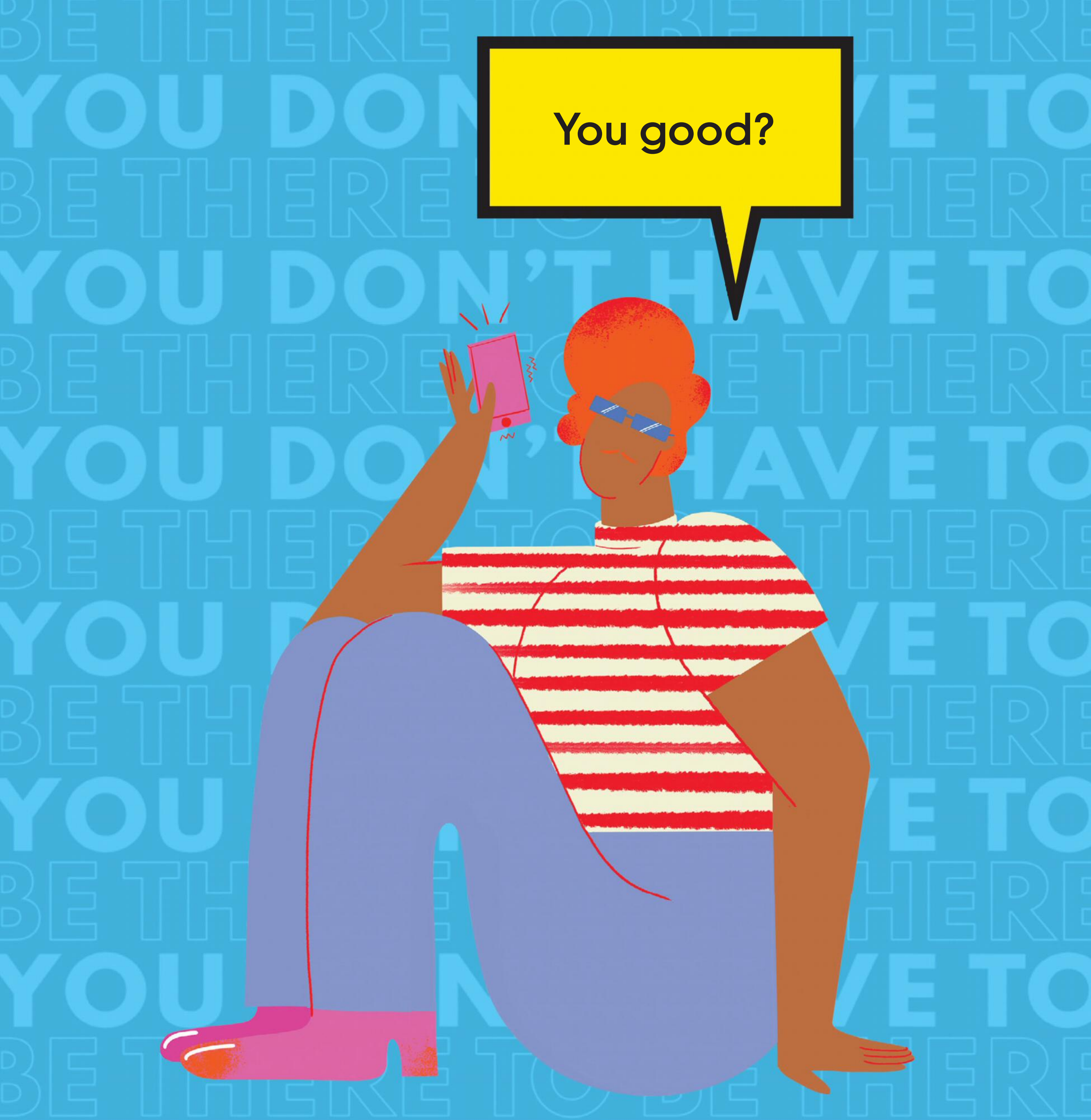
LET THE MAC REVOLUTION BEGIN!

MacBook Air
MacBook Pro

WHICH M1 MAC?
REVIEWED:
MACBOOK PRO,
MACBOOK AIR,
& MAC MINI

THE SWITCH TO APPLE SILICON HAS BEGUN.
AND IT LEAVES INTEL IN THE DUST.

INSIDE
BUYING AN M1 MAC: EVERYTHING YOU NEED TO KNOW


You good?
YOU DON'T HAVE TO BE THERE TO BE THERE

Reach out to a friend about their mental health.

Find more ways to help at **SeizeTheAwkward.org**

SEIZE THE AWKWARD ad COUNCIL American Foundation for Suicide Prevention JED The Jed Foundation

Macworld INCORPORATING MACUSER

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MACUSER

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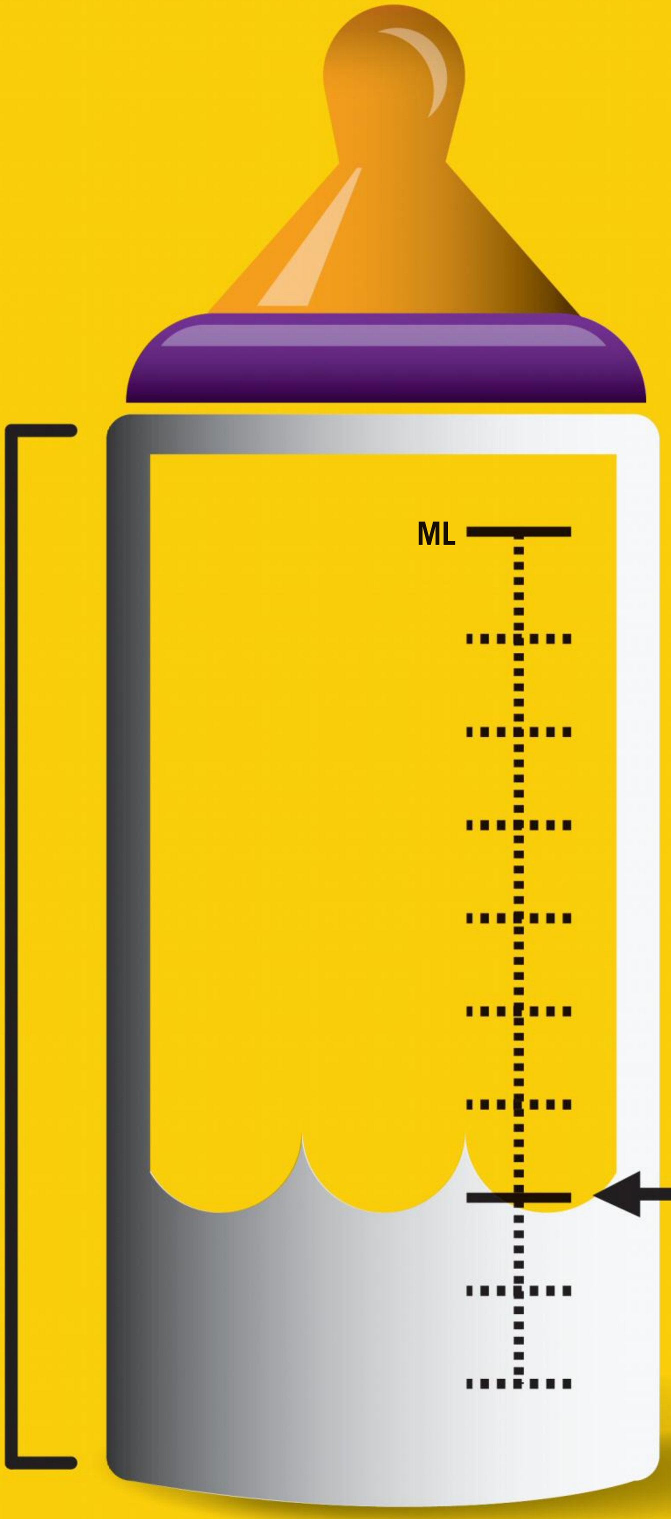
THE NUMBER OF PEOPLE

WHO THINK

THEY HAVE THEIR CHILD IN THE RIGHT SEAT.



THE ONES

WHO ACTUALLY DO.

KNOW FOR SURE

IF YOUR CHILD IS IN THE RIGHT CAR SEAT.

Ad Council

VISIT SAFERCAR.GOV/THERIGHTSEAT

NHTSA
www.nhtsa.gov

Child Car Safety

Apple M1 Macs: What you need to know about buying a new Mac with Apple silicon

Shopping for a new Mac, but you have questions? We answer them in this FAQ.

BY MACWORLD STAFF

MacBook Pro
MacBook Air

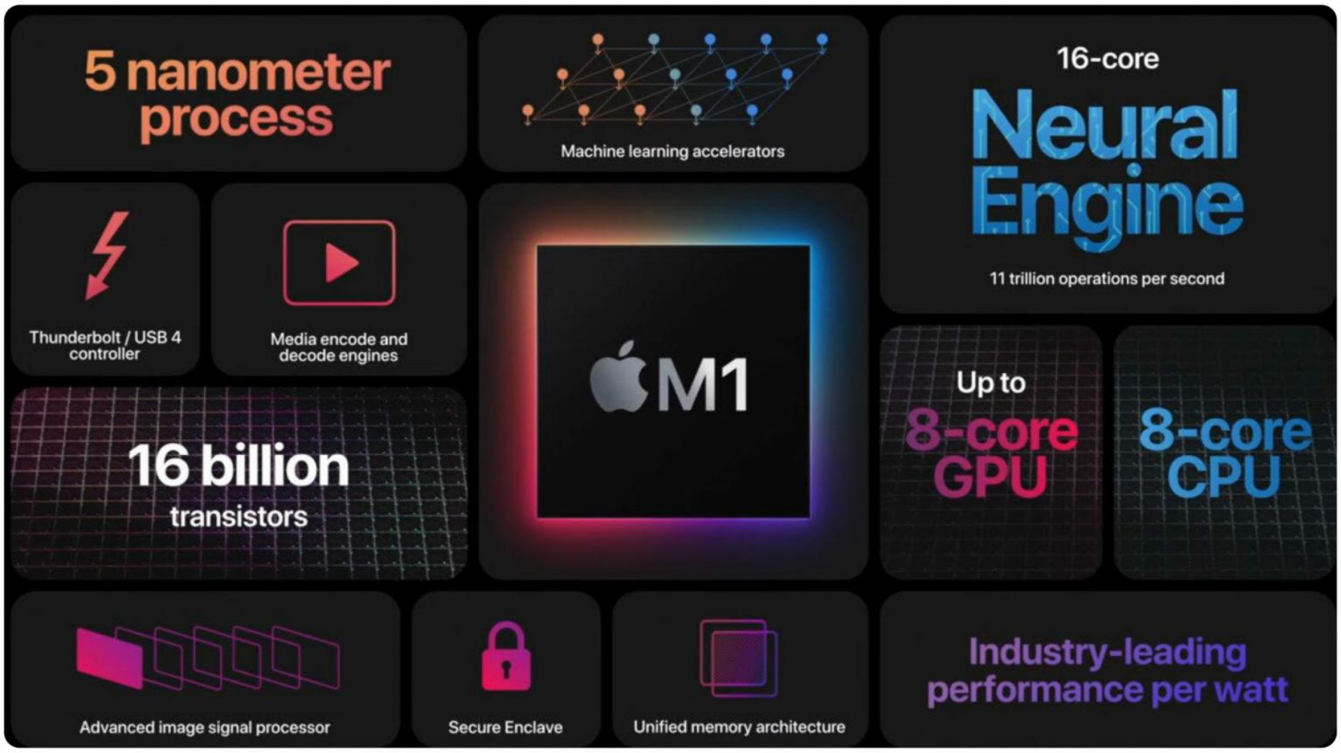
Macs are undergoing a big change. Apple is switching its internal architecture from one that uses Intel CPUs, third-party graphics processors, and other parts, to the company's own "system on a chip." The first Apple silicon SoC for Macs is called the M1 (go.macworld.com/mcm1).

It's a big step for Apple and the Mac. But what does it mean for you? In this article, we cover what Apple's system on a chip means to the user, how it affects what software you can use, and answer other frequently asked questions.

WHAT IS THE 'APPLE SILICON' M1 SYSTEM ON A CHIP?

"Apple silicon" refers to the chips Apple makes. In the Mac, they replace the Intel processors they have used for the past 14

IMAGE: APPLE


5 nanometer process
Machine learning accelerators
16-core
Neural Engine
11 trillion operations per second
Thunderbolt / USB 4 controller
Media encode and decode engines
M1
16 billion
transistors
Up to
8-core GPU
8-core CPU
Advanced image signal processor
Secure Enclave
Unified memory architecture
Industry-leading performance per watt

years, and will eventually also replace the AMD graphics processors in higher-end Macs. Apple silicon first made its appearance in the original iPad.

The M1 is Apple's first Mac chip. Here are its specifications:

> 5 nanometer (go.macworld.com/5nmp) process technology
> 8-core CPU
> 4 performance cores
> 4 efficiency cores
> 7- or 8-core graphics processor (GPU)
> 16-core Neural Engine
> 8GB or 16GB of RAM

Apple calls this a system on a chip (SoC) because it takes several components that are usually separate and puts them all on a single chip. This includes the CPU, graphics processor, USB and Thunderbolt controllers, Secure Enclave, Neural Engine, image signal processor, audio processing hardware, and more. This results in better performance and battery life. Read all about Apple's claims about the M1's performance and battery efficiency (go.macworld.com/bold).

WHAT MACS USE APPLE SILICON?

Apple decided to initially release its own silicon in its more affordable Macs that are popular with general consumers. These Macs are:

$999 and $1,249 MacBook Air (see page 72)

$1,299 and $1,499 13-inch MacBook Pro (see page 86)

$699 and $899 Mac mini (see page 98)

Apple announced a two-year transition, meaning that within two years every Mac will have chips of Apple's own design. So more Macs with Apple silicon are coming.

CAN I GET AN M1 MAC WITH MORE THAN 16GB OF RAM?

Not with these first models. The amount of memory in the M1 Macs is a point of contention for some customers, especially those who are used to the practice of having as much RAM as they can in order to do their work.

Apple silicon uses a "unified memory architecture," which is different from how memory is traditionally used in computers, including Intel Macs. UMA is efficient and fast, and it is possible that you may not need as much RAM as you think. Get the lowdown on Apple's unified memory

The M1 chip massively improves the Mac mini's performance.

architecture and how memory is used in Apple silicon (see page 15).

ARE MACS WITH INTEL PROCESSORS STILL AVAILABLE?

Apple's pricier Macs still use Intel processors (including the more expensive 13- and 16-inch MacBook Pro, and the $1,099 Mac mini). These Macs are bought mostly by power users who do demanding work.

It's not that Apple's M1 can't handle the workload. It can, but the users of these Macs want more RAM, more powerful GPUs, and other features not found on the M1 Macs. Apple is not ready with silicon that will replace the Intel processors in these more expensive Macs.

Apple said its silicon rollout will occur in a two-year period, so the M1 is just the start. Apple will eventually outfit all of its Macs with its own silicon, and Intel processors will be completely phased out. Learn more about Apple's transition from Intel to Apple silicon (go.macworld.com/in2s).

SHOULD I NOT BUY AN INTEL MAC?

In our reviews of the M1-equipped MacBook Air, 13-inch MacBook Pro, and Mac mini, we saw tremendous performance. They're definitely quite a lot faster than their Intel counterparts. And with the laptops, the battery life extends hours and hours beyond what was previously found in Intel-based models. If you're considering a lower-priced Mac, it's hard to argue against the new M1-based models.

The Intel Macs are still good performers, though. If the Mac you are considering has an Intel processor, you do not need to rule it out. They are good computers. However, if you are not in a rush at all, you might want to wait and see what Apple will offer for the iMac, iMac Pro, Mac Pro, and the more expensive MacBook Pros. The Apple silicon for these Macs could be even more impressive than the M1.

WILL APPLE STILL SUPPORT INTEL MACS?

Apple said it will continue to provide to support its Intel Macs even after its Mac product line has fully switched to Apple silicon. Apple has sold millions of Intel Macs over the years and it knows that many of its customers use their Macs for a long time. Eventually, Apple will stop supporting Intel Macs, but that will not happen for several years.

You can probably expect new versions of macOS, and their accompanying apps, to be made available for Intel-based Macs until at *least* 2024, and official Apple technical support will extend far beyond that.

WILL MY SOFTWARE RUN ON AN APPLE SILICON MAC?

Apple has gone to great lengths to make sure software works on its new processors. If you use Apple apps such as iMovie, Pages, Keynote, and more, they will work on Apple silicon. Most third-party software, from large corporations or from small developers, will work. (The ways your software works on Apple silicon Macs is described in the next section.)

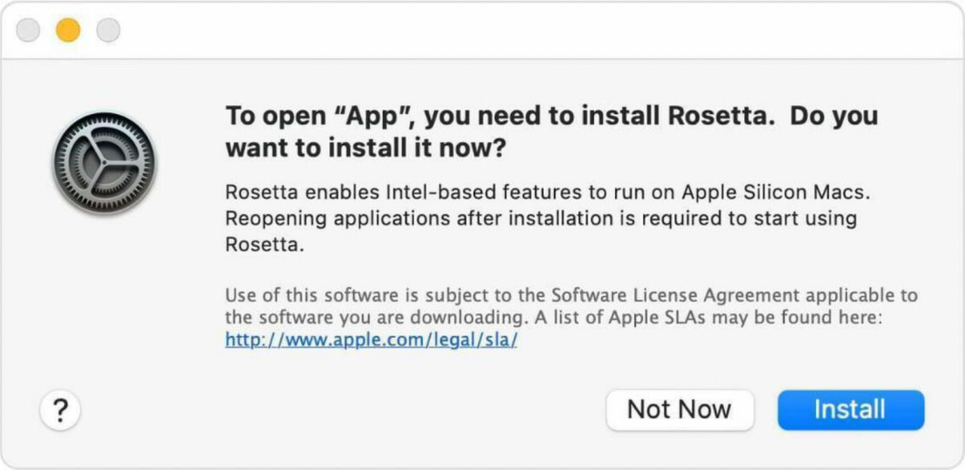
There are a few circumstances where your software may not work. If you are using an app that has not been updated in a long time, it may not work. If you have custom-made software, there could be issues. If you are still using an app that was discontinued, there is a chance it will not run. Most of the initial compatibility problems seem to stem more from apps that were not updated to support macOS Big Sur (go.macworld.com/bsur), which ships on Macs with the M1.

Before buying an Apple silicon Mac, it is a good idea to check with the developers of your favorite apps for compatibility. The status of your software can help you determine whether you can invest now or you should wait. For example, as of this writing, Avid Pro Tools (go.macworld.com/avid), a popular audio editing suite, is not compatible with both Apple silicon and macOS Big Sur. Those customers need to wait.

The website Is Apple silicon ready (go.macworld.com/slrd)? maintains a list of software and their levels of compatibility. You can see if an app has a native version, works in Rosetta2, or does not work at all.

WHAT'S ALL THIS ABOUT 'UNIVERSAL' APPS, 'EMULATION', 'ROSETTA2', AND 'NATIVE' SOFTWARE?

Software is created with specific hardware in mind. In the past, software was made for Macs with Intel processors, which use the x64 instruction set. Now, software needs



To open "App", you need to install Rosetta. Do you want to install it now?

Rosetta enables Intel-based features to run on Apple Silicon Macs. Reopening applications after installation is required to start using Rosetta.

Use of this software is subject to the Software License Agreement applicable to the software you are downloading. A list of Apple SLAs may be found here: http://www.apple.com/legal/sla/

The first time you run a non-native app on an Apple silicon Mac, an alert appears asking if you want to install Rosetta, the translation layer needed to run the app. Once it is installed, it works for all the apps that need it and you won't see this alert again.

to be created for both Intel and Apple silicon (which uses the ARM instruction set) in order for the software to work efficiently and properly for each platform.

There are a few terms bandied about to describe the platform software is created for. Here are those terms and what they mean.

Native: Software that is written specifically for the platform it is being used on. Software that is native for Apple silicon runs only on Apple silicon. Learn more about native apps on Apple silicon (go.macworld.com/ntve).

Universal: Software that is made to run on both Intel and Apple silicon Macs.

Emulation: The ability to take an app written for one platform and translate it so that it works on another platform.

Rosetta2: The name of the software translation tool Apple uses. Learn more about using apps under Rosetta2 (go.macworld.com/rst2).

DO iPHONE AND iPAD APPS WORK ON APPLE SILICON MACS?

They can. It is up to a developer whether they want to make their apps available for the Mac. To see if an iPhone/iPad app is available, check the App Store on an Apple silicon Mac. (iPhone/iPad apps do not appear in the App Store for Intel Macs.) If you already paid for an app for your iPhone/iPad, you do not have to buy it again.

Since the Mac doesn't have a touchscreen, Apple has Touch Alternatives to help you use an app; for example, you use the Mac's arrow keys to perform a swipe. iPhone apps run at a fixed window size, while some iPad apps are resizable.

WILL MY HARDWARE DEVICES AND ACCESSORIES STILL WORK WITH APPLE SILICON MACS?

The Apple silicon Macs come with Thunderbolt/USB 4 ports. If you have been using a Mac with Thunderbolt 3/USB-C ports, you can connect to the new Macs the same way and your gear should work. The Thunderbolt/USB connectors are the same shape, and have most of the same technical capabilities.

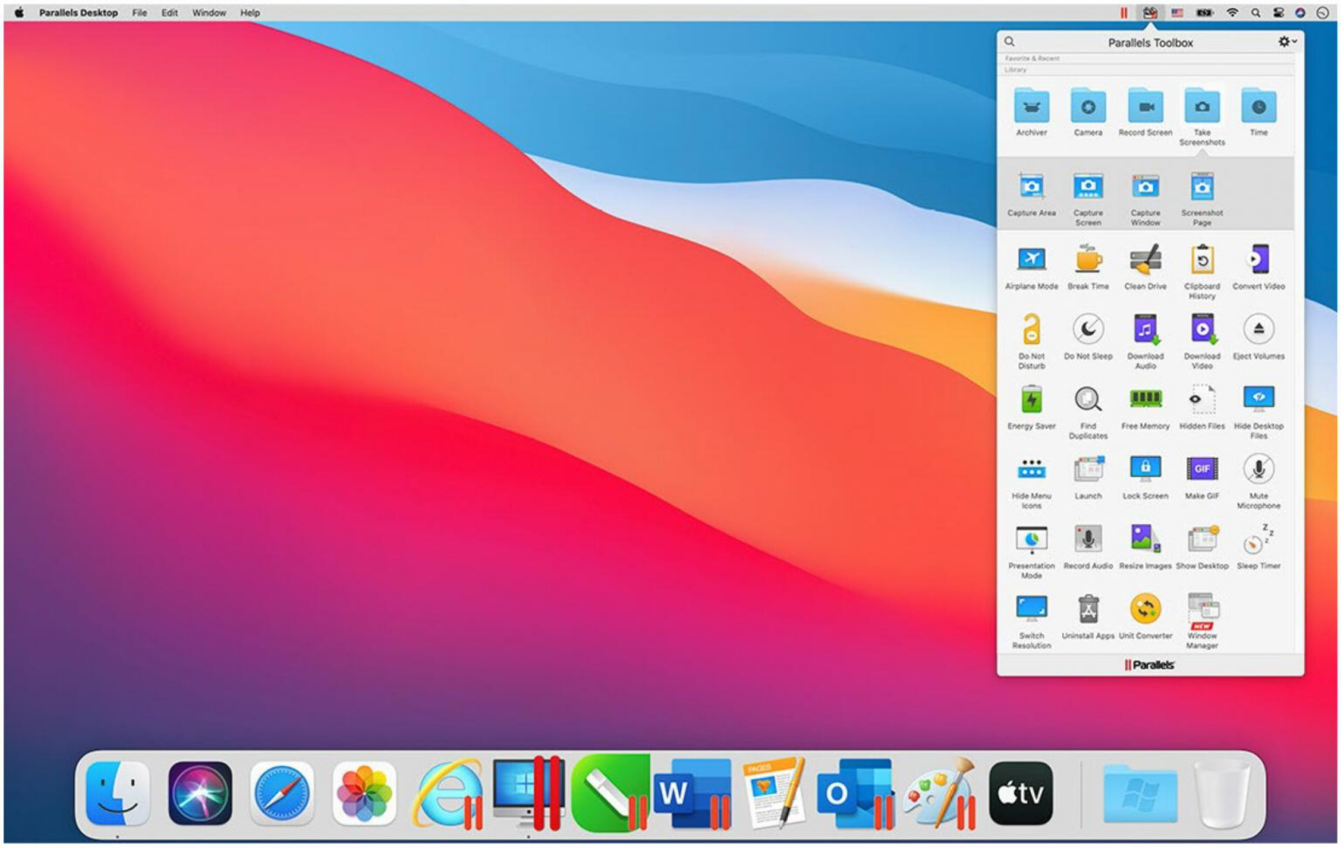
If you are using USB-A to USB-C adapters or a hub, they should still work.

Wireless devices on the new Mac can use the same wireless connection you have been using on the old Mac.

If you are using high-end production equipment, check with the device manufacturer about compatibility before you invest in a new Mac.

CAN I USE MY CASE/COVER/BAG WITH APPLE SILICON LAPTOPS?

The M1 MacBook Air uses the design that was introduced in 2018. The M1 13-inch


Parallels Desktop
File
Edit
Window
Help
Parallels Toolbox
Favorite & Recent
Library
Archiver
Camera
Record Screen
Take Screenshots
Time
Capture Area
Capture Screen
Capture Window
Screenshot Page
Airplane Mode
Break Time
Clean Drive
Clipboard History
Convert Video
Do Not Disturb
Do Not Sleep
Download Audio
Download Video
Eject Volumes
Energy Saver
Find Duplicates
Free Memory
Hidden Files
Hide Desktop Files
Hide Menu Icons
Launch
Lock Screen
Make GIF
Mute Microphone
Presentation Mode
Record Audio
Resize Images
Show Desktop
Sleep Timer
Switch Resolution
Uninstall Apps
Unit Converter
NEW
Window Manager
Parallels

Parallels has announced that it is working on compatibility with Apple silicon Macs.

MacBook Pro uses the design that was implemented in 2016. If your gear is made for these laptops, it will work with the new M1 laptops.

WHAT VERSION OF MACOS DO APPLE SILICON MACS WORK WITH?

These new Macs come with macOS Big Sur, which is version 11 of the Mac operating system. They do not work with previous versions of macOS.

This could be an issue for users who prefer to use an older version of macOS. For example, some users continue to use macOS Mojave because it is the last version to support 32-bit software (go.macworld.com/32bi). In this situation, you need to upgrade those 32-bit apps to 64-bit versions, or find 64-bit replacements before you can go with an M1 Mac.

CAN APPLE SILICON MACS RUN WINDOWS?

As of this writing, Boot Camp (go.macworld.com/bocm) does not work with Apple silicon Macs, so you can't boot into Windows. Apple has said that these Macs can do it (go.macworld.com/thes), but you would have to use Microsoft's ARM version of Windows. Microsoft's license currently does not allow for installation on a Mac, so it's up to Microsoft to decide to do it.

Also, virtualization software such as Parallels (go.macworld.com/para) and VMware Fusion (go.macworld.com/vmwr) do not yet work. Both Parallels and VMware announced that they are working on compatibility. A recent report (go.macworld.com/dvwn) said that the developers of Wine (go.macworld.com/w1ne) are "experimenting" with Apple silicon support. No announcement has been made about VirtualBox (go.macworld.com/vb0x).

CodeWeavers' CrossOver virtualization works, according to the company (go.macworld.com/xovr). CrossOver doesn't emulate the Windows OS, though. It allows the Mac to run software that was made for Windows. If you've never used CrossOver, there is a free trial (go.macworld.com/ftrl) you can try to see if it addresses your needs.

HOW DO I TRANSFER MY DATA FROM AN OLD INTEL MAC TO A NEW APPLE SILICON MAC?

This procedure has not changed because of Apple silicon. We have a guide that explains the ways you can quickly move everything from your old Intel Mac to your new M1 MacBook (see page 22). ■

With M1 Macs, memory just isn’t what it used to be

Apple has changed the way RAM is used in a computer.

BY JASON SNELL

The first Macs powered by Apple-designed processors are finally here. And from the outside, they’re almost dead ringers for the Intel-based Macs they’re replacing.

But on the inside, they’re not like other computers. Apple has brought its approach to system design, learned through years of iteration on the iPhone and iPad, to the Mac for the first time.

Those of us who are used to thinking of personal computers in certain terms are going to need to adjust to this new reality. It’s a world in which Apple sells three different Mac models without even disclosing the clock speed of the

IMAGE: IDG

processor inside. (It doesn't do it for the iPhone or iPad, after all.)

But perhaps the item on the spec sheet that will require the biggest diversion from the old way of thinking is system memory. It's a feature that's already frequently misunderstood (and frequently confused with storage size), and now Macs with Apple silicon are using it in an entirely different way.

The old way of thinking of RAM is dead. Welcome to the world of the Unified Memory Architecture.

PART OF THE PACKAGE

Like Intel chips with integrated graphics, the M1 chip includes a graphics processor, and system memory is shared by both processor cores and graphics cores. (And also, in the M1's case, the cores that make up the Neural Engine.) But in shifting its terminology to describe a unified memory architecture, Apple's trying to point out that the M1's approach is a bit different (go.macworld.com/m1ap).

The biggest difference is that in the M1, the memory is a part of the M1 architecture itself. There's no memory slot or slots on the motherboard of an M1 Mac, nor is there an area where a memory chip has been permanently soldered on. Instead, the memory is integrated into the same package that contains the M1 itself.

What this means is that when you buy an M1-based Mac and choose a memory configuration, that's it. There have been many other Macs with soldered-on memory that couldn't be upgraded, but this is a little different, since the memory is basically part of the M1 package itself.

The first round of Apple silicon Macs, which include the Mac mini, can have a maximum of 16GB of memory. That could be by design.

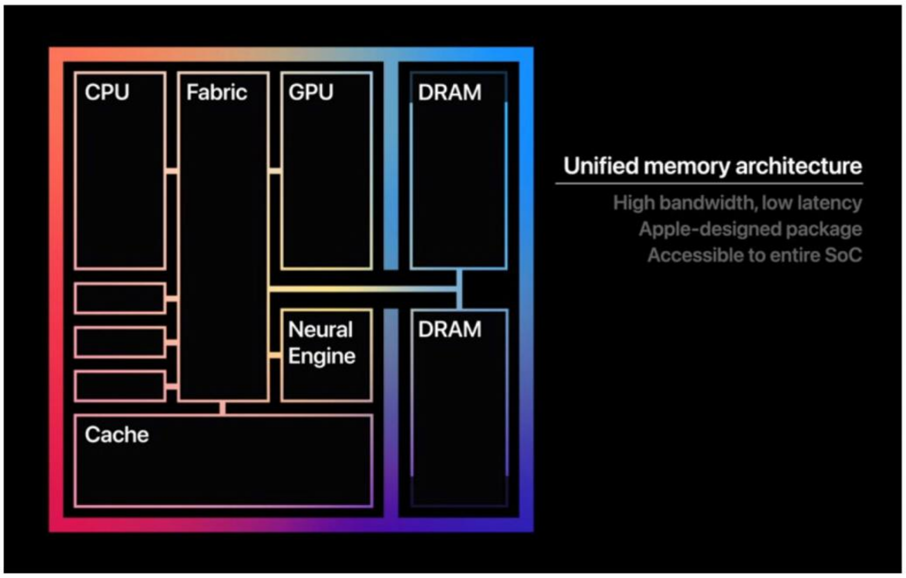
Looking at the first round of M1 Macs, it seems that the M1 is only capable of using 8GB or 16GB of memory. That may not actually be a hard limit—perhaps Apple is holding back in order to limit these low-end systems. But it's more likely that we won't see Macs running Apple silicon with more than 16GB until Apple provides a higher-end variant of the M1.

BENEFITS OF BEING UNIFIED

But Apple isn't integrating memory into its systems-on-a-chip out of spite. It's doing it because it's an approach that can lead to some dramatic speed benefits.

The M1 processor's memory is a single pool that's accessible by any portion of the processor. If the system needs more memory for graphics, it can allocate that. If it needs more memory for the Neural Engine, likewise. Even better, because all the aspects of the processor can access all of the system memory, there's no performance hit when the graphics cores need to access something that was previously being accessed by a processor core. On other systems, the data has to be copied from one portion of memory to another—but on the M1, it's just instantly accessible.

These new Macs are, in their way, kind of alien. The tradition in personal computers was that everything was modular, an outgrowth of the early PC era. Even though the Mac never participated in the build-a-PC ethos, the parts Apple used to assemble Macs came from that industry. Compare that with the smartphone, where Apple has continued to integrate more portions of the system into its single processor package in order to increase efficiency. These new Macs are far more like smartphones than like traditional PCs.



DO YOU NEED IT?

One of the biggest criticisms I've seen about this first round of M1 Macs has been that they just don't offer enough memory, maxing out at 16GB. Keeping in mind that these are the lowest-powered Mac models, it's likely that future models will offer more RAM options.

But it's also worth considering just how squishy the need for more memory can be when you poke at it. Sure, a lot of people feel they need it—but do they, really?

Yes, when a Mac runs out of physical memory, it will page the contents of memory to disk—and even super-fast SSDs are slower than main memory! Though the speed differences are a lot less than back when we used slow spinning disk drives.

What would cause your Mac to run out of physical memory? If you leave an awful lot of apps open at once, or if your browser has hundreds of tabs open, or if you're using an app that loads a very large file (like, say, a Photoshop file) into memory. If you're someone who does this a lot, you probably want more memory.... but then again, if you're someone who does this a lot, you might not want to buy one an M1 Mac right now. The mid-range and high-end models that will undoubtedly offer more RAM options and more processor power are undoubtedly coming next year.

But if you combine the efficiency of the unified memory architecture with the speed of SSD storage, and consider most everyday use cases, I'm pretty sure that most regular users could get by with 8GB of unified memory—or, if you want to be absolutely sure, upgrade that to 16GB. (I did.)

An Apple silicon Mac Pro with only 16GB of memory? It won't happen. You'll see Apple silicon with more RAM and processing power in the near future.

WHAT'S NEXT?

I can't imagine 2021 passing without Apple rolling out a new set of Macs with more powerful processors and more memory options. The high-end MacBook Pros and the iMacs, at the very least, could use updates that provide some options beyond the basic M1.

In the long run, is it possible that Apple would build systems with external graphics processors with their own dedicated memory? It seems inevitable, at least at the high end—what's a Mac Pro for if you can't stick a ridiculous graphics card in it?

But Apple is also very likely to just keep scaling up memory options as it scales up its processors, adding more memory as it adds cores—and those chips are the ones likely to be offered in most Mac models.

The unified memory architecture in the M1 is one of the reasons these Macs are so amazingly fast—but all Mac users are going to have to relinquish some of our assumptions about how our computers work, and how they're configured. And if you really can't bear buying any Mac with only 16GB of RAM, don't get mad—be patient. More Apple silicon Macs are on the way. ■

Imagining the possibilities with Apple silicon

What other features could Apple silicon enable on Apple's computers?

BY DAN MOREN

Projects
My Media
Audio
Titles
Backgrounds
Transitions
Lake Trip
All Clips
Search
Cousins Trip
Reset All
00:13 / 00:24
Settings
Voiceover 1
Kids Playing
MacBook Air

The M1 Macs have arrived. The benchmarks are in. And what we've seen is nothing less than mind-blowing performance from Apple's own silicon, compared to the Intel chips that came before. But this, as we know, is just the beginning. The M1 is only the first in a whole family of chips that will be powering Macs from now on.

As impressive as these new processors—and the improvements they bring in speed and battery life—are, some have felt underwhelmed by the new Macs, given that they look pretty much identical to the models they're replacing. This was by design, of course, to impart a feeling of continuity from Apple's existing models, assuring customers that fundamentally nothing has changed.

But as we look forward to the next

IMAGE: APPLE

generation of Macs that are no doubt working their way down the pipe even as we speak, it's time to start thinking about what other features Apple's unprecedented control over the hardware and software might enable the company to bring to its most venerable product line.

FACE THE MUSIC

As an owner of a brand new M1 MacBook Air—replacing my six-year-old model—I've been delighted with the addition of Touch ID. Being able to quickly and easily authenticate for access to everything from systemwide settings to my 1Password vault is great, and way better than laboriously typing my administrator password every time.

But. I have to admit that I find myself missing Face ID. Yes, it's not always perfect—sometimes it can't recognize me because of the mask I wear wherever I go or other times because I'm all bundled up against the encroaching winter. Sometimes I still need to still enter my password like I'm from olden times. But on the whole, Face ID still often feels magical—like my device knows me.

Face ID certainly seems like it's ripe for inclusion the Mac in the near future. Apple took some flack for not beefing up the front-facing cameras in the new M1 MacBooks, but to me that suggests that it's planning a more substantive update. And while simply updating the camera to 1080p would help, why limit yourself that when you could instead bring the TrueDepth camera package and Face ID to the Mac?

Unlock with Touch ID →
delete

Touch ID is nice. Face ID is better.

Doing so would also solve the problem of the lack of the biometric authentication on the iMac. While the idea of an external keyboard with Touch ID has been floated, I have to imagine there are some security concerns with incorporating the biometric sensors on an external piece of hardware. Face ID would obviate that, by being built right into the main display. Plus, there's no better feeling than waking up your Mac and having it recognize you.

AT A CELLULAR LEVEL

Most of Apple's other devices have long had some form of cellular connection, whether it be the iPhone (obviously), the iPad, or even the Apple Watch. And yet, in all this time, the MacBook has never made the cut.

It's not outlandish: plenty of PCs boast cellular connections for those times when you're not near a Wi-Fi signal. Sure, you can tether your laptop to your smartphone—if your plan allows it—but adding a cellular option to MacBooks would still likely be a welcome development for those looking for an all-in-one package.

Plus, let's not forget that Apple is soon to start building its own cellular radios. While those are predominantly destined for the iPhone and iPad, it's not hard to imagine that the company might, now that it's producing those chips in bulk, include them in other devices. It's not a sure thing, of course, but it's another way to show just how many capabilities Apple's custom silicon unlocks.

NANO NANO

Keeping things largely the same is, as we've discussed, a strategic move. But once the transition is finished, Apple has the chance to revisit and rethink some of its longstanding Macs, and no model is perhaps more ripe for a radical redesign than the Mac mini.

Teardowns of the new M1 mini have exposed a frankly jaw-dropping amount of space inside the interior. As someone who's taken apart multiple Mac minis, these little computers were always impressive in the way that Apple had managed to shoehorn in so much technology, packing the cramped boxes to the gills via clever engineering.

But Apple's own internals are much, much more compact than their predecessor; it seems clear that Apple simply dropped its new board inside the Mac mini enclosures that it had sitting around, leaving plenty of room inside the units for...air?

It's not hard to imagine a Mac mini that's much smaller than the current version, perhaps more the size of an Apple TV—an incredibly powerful desktop computer that can, unbelievably, fit in one's pocket. If the company decides to invest in a smaller configurable tower to scratch the itch of those who need configurability, why not create an even smaller desktop Mac—a Mac nano—to provide a basic, entry-level experience? The potential is clearly there; it's just a question of whether Apple thinks there's a market for such a computer, competing against rivals like the Raspberry Pi and Intel's NUC.

But, if nothing else, it's hard to argue that there would be a certain amount of awe-factor from producing the smallest desktop Mac ever. And that's the real power of Apple silicon: the ability to rethink all the assumptions that we've all made about these computers that have been around for decades. ■

How to quickly move everything from your old Intel Mac to your new M1 MacBook

Get up and running faster than you can say Apple silicon.

BY MICHAEL SIMON

When you buy a new iPhone, getting it all set up (go.macworld.com/setu) takes minutes. All you need to do is back up your old phone and sign in to your iCloud account on your new phone, and you can pick up right where you left off, home screen layout, open Safari tabs, and all.

It's not quite as simple on the Mac. While Apple offers several ways to transfer files from one machine to another, none of it is as simple as iCloud backups on iOS. But if you know which toggles to flip, apps to sync, and folders to share, it doesn't have to be so hard. Just follow our guide to getting everything set up on your new Mac.

APPLE SERVICES, PASSWORDS, AND APPS

First the easy stuff. If you subscribe to any Apple services, you only need to log into your iCloud account for the appropriate service—Music, TV, Arcade, News, etc.—to get back in sync. Your music and movie library, favorite shows, games, channels, and magazines will all sync and be ready to go.

The same goes for the other Apple apps you use: Mail, Contacts, Calendar, Safari, Photos, and Notes, as well as any stored passwords in your keychain. And since Safari is essentially a password manager now, you'll be able to see all of your saved passwords from your old machine no matter how many years it's been since you last logged in. Just head over to the Apple Account tab in System Preferences (or iCloud in pre-Catalina macOS) and make sure everything you want to sync is checked off.

iCLOUD DRIVE

There might not be an official way to back up everything to Apple's online locker, but you can still use your iCloud account to transfer important files between machines. Inside the same Apple Account/iCloud preferences above, you'll see a Desktop and Documents Folders checkbox, which will sync your file across all of your devices.

You'll need some space, though. Apple

Your iCloud Drive can help get your new Mac up and running in no time.

only gives you 5GB of free space per account, so you'll likely need more if you want to store a bunch of files. Apple offers monthly storage plans (go.macworld.com/stpn) of 50GB for a buck, 200GB for $3, and 2TB for $10.

You can transfer files over USB-C using Migration Assistant.

When you log into your new Mac, you should see an iCloud tab in the sidebar of your Finder window, but if it's not there, you can add it in the Finder Preferences. Once they appear, you merely need to drag out the relevant files to your desktop and download any documents you want to store locally by clicking on the cloud icon.

You can also use your iCloud Drive to transfer files that aren't in your Documents folder just by dragging them in. For example, if you want to save all of your downloads, simply drag the folder from your old Mac into your iCloud Drive and drag it out again on your new Mac.

MIGRATION ASSISTANT

For the rest of your data—apps, media, projects, downloads, etc.—you can use Apple's built-in Migration Assistant (go.macworld.com/migr). During setup on your M1 MacBook, you'll be presented with an option for transferring your data from a Mac.

To start the process, you'll need to open Migration Assistant on your old Mac, which can be found inside the Utilities folder in Applications, and connect the two machines using Wi-Fi or using a USB-C cable (which will be much faster). Then, simply select what you want to transfer to your new Mac (Applications, Users, Other Files, and System/Network Preferences), and click continue. You'll probably need to let it run for a while, especially if you're transferring over Wi-Fi, but once it's done, all of your files will be on both machines.

You can also choose to complete this process after you've gone through the initial Mac setup but launching Migration Assistant on both machines. That way you won't have to wait a moment longer to start using your new Mac.

TIME MACHINE

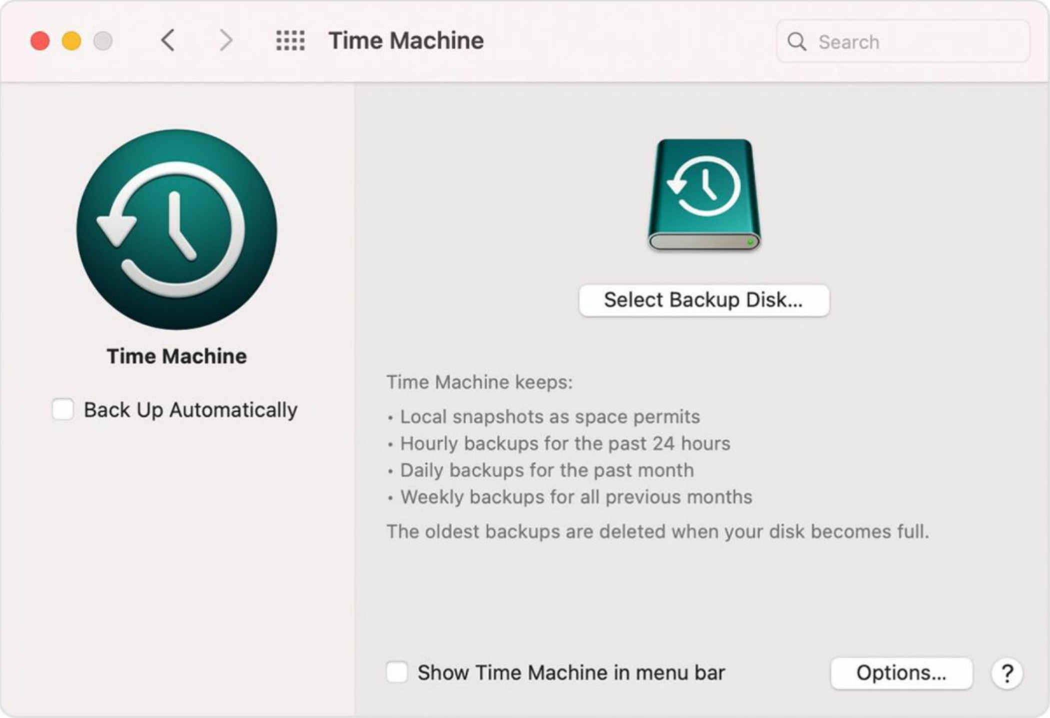
Finally, the absolute best way to get your new Mac looking like your old one is to restore from a Time Machine backup. You'll need an external drive to get things going, but once you plug in, you'll be able to make a full-on clone of your old machine that will restore to your new one.

To get started, plug in your drive and head over to the Time Machine tab in System Preferences. Select your disk, pick any folders that you want to exclude from the backup, and start the process. Your first backup will likely take a couple of hours, but subsequent backups—which will be completed daily and stored monthly if you opt to back Up Automatically—will take mere minutes.

When you're setting up your new machine, you'll only need to select the latest Time Machine backup to restore everything on your old machine to your new one. It'll be just as if you had been using the new M1 MacBook all along, with all of your apps and files where they belong.

CUSTOMIZATION

No matter what method or methods you chose above, the only thing you'll need to do is change your wallpaper, organize your Dock, and tweak any other appearance settings you'd like to customize. If you've turned on the System Preferences sync in the iCloud settings, some small settings will migrate over (like the position of the Dock, for instance), but the larger things will need to be re-adjusted. Just think of it as a chance to start fresh. ■



☐ Back Up Automatically

Time Machine keeps:
- Local snapshots as space permits
- Hourly backups for the past 24 hours
- Daily backups for the past month
- Weekly backups for all previous months

The oldest backups are deleted when your disk becomes full.

☐ Show Time Machine in menu bar

The best way to get your new Mac looking like your old one is to restore from a Time Machine backup.

I really want to buy a crazy-fast M1 MacBook Pro. Here's why I'm not

They almost had me.

BY MICHAEL SIMON

MacBook Pro

The reviews for the new M1 MacBooks are here (see pages 72 and 86) and they're spectacular. They're not just faster than the previous Intel machines, they're among the fastest Apple laptops ever made, with some tests besting even the flagship 16-inch MacBook Pro. And I really, really want one.

I've made no secret (go.macworld.com/nose) of my intention to hold off on buying a new Mac until Apple started using its own silicon (go.macworld.com/apsi) inside, and the day finally arrived. The Apple Store was down, the event clock was ticking down, and I was ready to buy my first new MacBook in nearly a decade.

Except I'm not. At least not yet, anyway. While there's a lot to like about the speed and battery life claims in the new M1 chip

IMAGE: APPLE

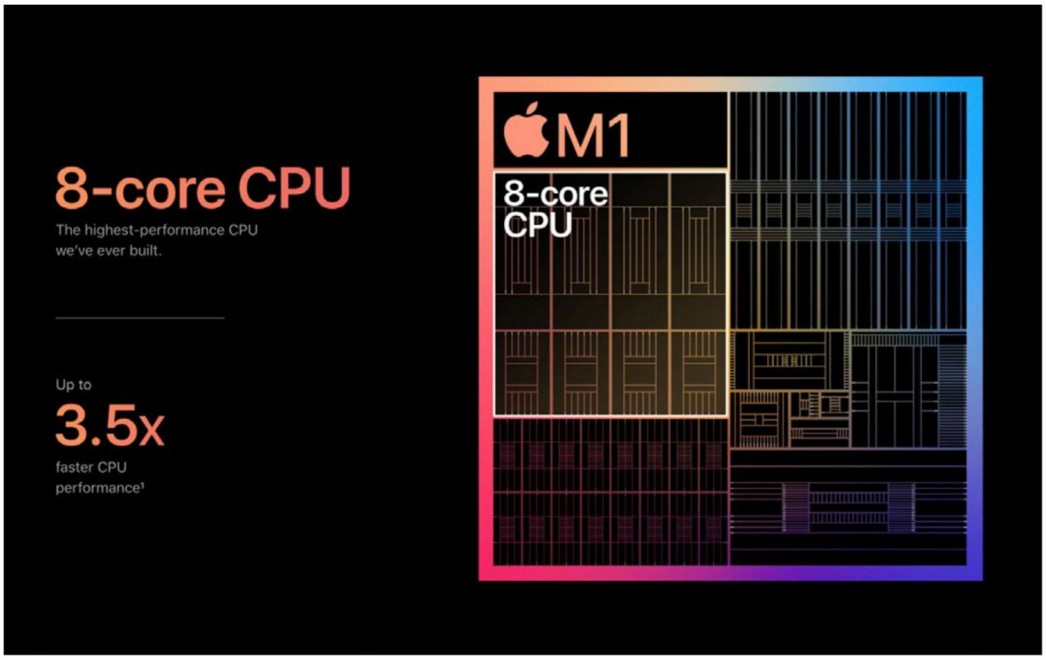
(go.macworld.com/nwm1) in the MacBook Air and MacBook Pro, there are just as many reasons to hold off on the purchase, especially if you're coming from an older high-end machine. It's not so much that I'm disappointed with the first M1 Macs as much as my curiosity is piqued.

My issue isn't with the design, which is a carbon copy of the Intel models. Sure, an edge-to-edge screen would be nice, as would a smaller footprint, Face ID, light-up Apple logo, and MagSafe integration, but the current design is plenty nice.

While there's no doubt that these machines are crazy fast for their prices—though there's *some* doubt that they're faster than the 98 percent of PCs (go.macworld.com/98pc) as Apple claims—there's also reason to believe that Apple is only scratching the surface with what it will deliver.

Take the ports. On the previous MacBook Pro lineup, Apple offered a $1,799 step-up option (go.macworld.com/inmp) that delivered four USB-C type Thunderbolt 3 ports rather than two on the base model. That's the configuration of my work machine and I use every one of the ports on a daily basis, as do a lot of users. But like the MacBook Air (go.macworld.com/inar), the new M1 MacBook Pro and Mac mini (see page 98) only have two Thunderbolt 3/USB 4 ports.

That's likely because the M1 chip only has a single Thunderbolt 3 controller—which also explains why both ports are on the same side—but it also means you can't buy an M1 Mac without being seriously hampered when it comes to USB ports. Assuming you're using one for charging, you're probably going to need a hub, which is an inelegant solution.



These machines are crazy fast for their prices.

Future MacBook Pro models, even smaller ones, aren't likely to have this restriction. Apple clearly understands that pro users need more than two Thunderbolt ports, which is why the 4-port Intel models are still on sale, for the same prices as before. Apple wouldn't have kept those aging Intel machines around if it didn't recognize the need for more ports, and I expect next year will bring M1 models with twice as many ports.

Ports aren't the only thing that's lacking with the new Macs. They're also capped at 16GB of RAM, the same limitation that the previous low-end models they replace had. Granted, 16 gigs isn't a small amount, but it's less than what power users want.

Here again, Apple understands the demand for more RAM and offers a 32GB upgrade for $400 in the higher-end Intel models. That's not a terrible price, but you're also being forced to choose between speed and memory. Early Geekbench benchmarks give the M1 a single-core score of 1630 and a multi-core score of 7220 compared to 1260 and 4480, respectively, on the still-shipping 2.0GHz Core i5 MacBook Pro. Even if those numbers are off by a magnitude of 10, the M1 is still significantly faster, with or without the extra RAM.

Two is the loneliest number.

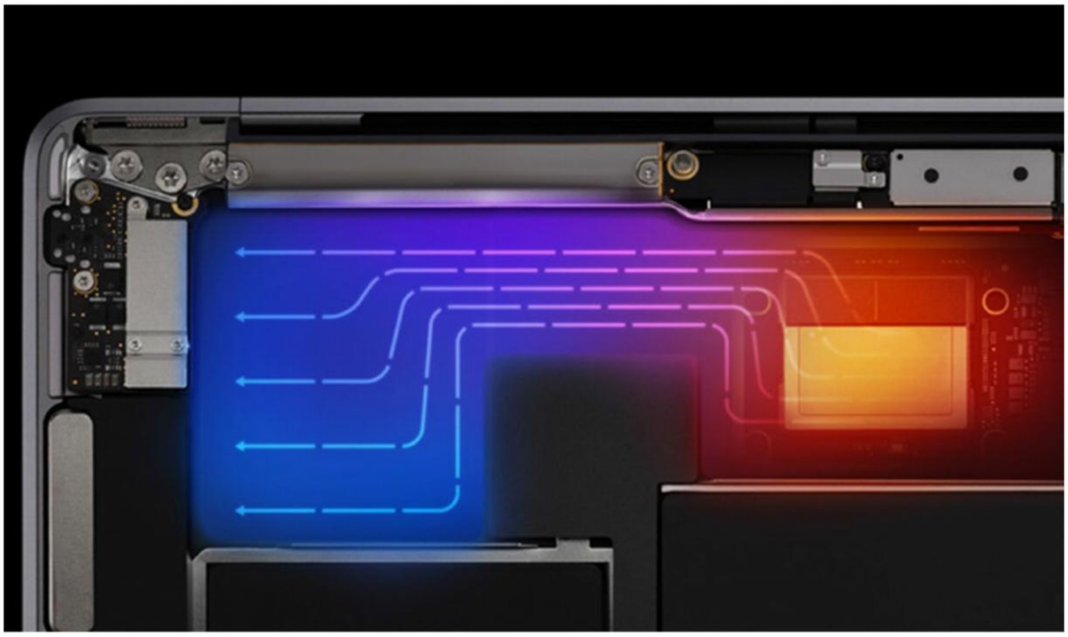
TICK, TOCK

But even if you don't need more than 16GB of RAM, it's still wise to wait. While we don't quite know how fast the M1 chip in the MacBook Air is compared to the one in the MacBook Pro, but we can assume it has a higher clock speed and sustained performance, if for no other reason than the Pro has a fan for cooling while the Air doesn't.

As Apple describes it, the fan in the Pro is needed to "sustain blazing-fast performance," while the Air uses an aluminum heat spreader to dissipate heat and deliver "amazing performance without a fan." While both machines will deliver tremendous speed boosts over the predecessors, it's pretty clear that the M1 in the Pro runs hotter and, by extension, faster.

And these chips are likely only a small part of what Apple will deliver

1929, respectively. That's a decent speed boost, and along with the lack of ports and RAM, it's clear that an M2 or M1Z chip is on the horizon.



The M1 MacBook Air has a aluminum heat spreader instead of a fan.

And that's the model I'm waiting for.

with its M chips. Based on the speed tests for the latest Intel MacBook Pros, there's a wide gap between the entry-level and the step-up models. Using the industry-standard Cinebench R20 benchmark, the 1.4GHz Core i5 scored 397 (single-core) and 1616 (multi-core), while the 2.0GHz model posted 436 and Rumors have claimed that there are 14-inch and 16-inch Macbook Pros in the works, and I fully expect them to deliver the specs I'm looking for, along with the massive speed boosts Apple has already delivered. And who knows, maybe we'll even get a decent FaceTime camera by then too. ■

Sorry Apple, I'm waiting for the next generation of Macs with Apple silicon.

Shaun & Aaron

Married September 26, 2015

Shaun & Aaron were denied a wedding announcement in their local newspaper.

In 30 states in this country, it's legal to discriminate against LGBT Americans. That means you can be fired from your job, evicted from your home, or even denied medical services because of who you are or who you love.

Everyone has the right to marry. Not everyone has basic rights.

Get the facts at **BeyondIDo**.org

GILL FOUNDATION

ad COUNCIL

belkin
Protected
Not Grounded

SURGE PROTECTOR

BELKIN SURGEPLUS USB WALL MOUNT SURGE PROTECTOR: THIS COMPACT OUTLET-MOUNTED GADGET CHECKS ALL THE BOXES

BY GLENN FLEISHMAN

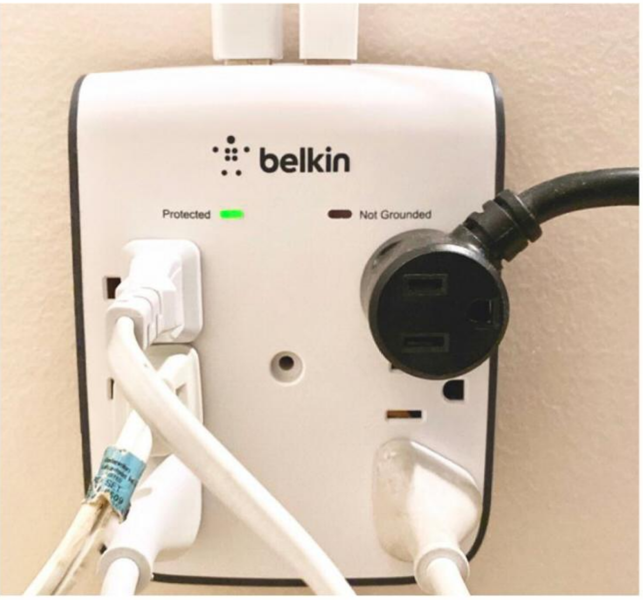
Belkin's SurgePlus USB Wall Mount surge protector offers a dense array of six AC outlets and two USB ports that fully covers a standard two-outlet wall jack. Like all surge protectors, it requires three-prong grounded outlets.

The SurgePlus plugs into a wall outlet's top position without removing the outlet's cover plate. A plastic protusion from the bottom anchors in the lower outlet's grounding plug. The surge protector comes with a long screw that can be removed or used to replace the cover plate's center screw for a more permanent installation and for additional anchoring

IMAGE: BELKIN

and stability. (Note that you'll need to remove the screw if you plug the unit into a Decora style outlet, which has screws at the top and bottom of the wall plate, but none in the middle.)

The model's six outlets are closely spaced, and it will work well only with standard two-prong and three-prong plugs typical for computer equipment and longer cords on AC adapters. (These are technically NEMA 5-15-P and 1-15-P styles [go.macworld.com/nema].) Those plug types have become more typical compared to the wall-wart design, which is not ideal for the SurgePlus. That's both because of available space, its vertical orientation, and the plug's rotation, 90 degrees off a wall outlet—its outlet blades are parallel to the ground instead of perpendicular.



The Belkin SurgePlus USB Wall Mount surge protector can accommodate six normal plugs and two USB Type A cables with ease, but it's not a good choice if you need something that will accomodate lots of wall-wart AC adapters.

The SurgePlus also includes two conveniently placed Type A USB charging ports, spaced just far enough apart at the top to accommodate even larger-than-average USB plugs. The two ports can output up to 2.1 amps (about 10 watts) between them, including allowing a single port to draw up to that amount of power if the other is unused.

Belkin opted for a moderate level of clamping voltage, the level at which the surge protector prevents excess power from flowing through and potentially causing damage. Surge protectors place a special kind of component, metal-oxide varistors (MOVs), across line/neutral, line/ground, and neutral/ground legs of the electrical circuit. Belkin opted to use MOVs that block surges above 500 volts. With modern electronics, that's not a problem, especially for quick transient voltage, the kind of surge experienced in most cases.

Belkin, however, chose to build this unit in a pass-through, where power continues to flow even after the MOVs on a given leg have burned out. The only indication that protection is no longer available is the green Protected LED on its top front.

Here, the SurgePlus has an advantage over surge protectors with a cord: it's very easy to see the bright green LED, although you still must remember to notice its

Belkin's surge protector plugs straight into your wall, so it has zero footprint. But you won't be able to use the stabilier screw in the center if you have a Decora-style outlet.

absence in order to take action and replace the unit. If you're concerned about power flowing with no protection, preferring it to stop when there's no bar against surges, you need to opt for a different surge protector (see our buyers' guide (go.macworld.com/buyg) for our current recommendation).

The SurgePlus also includes a Not Grounded warning red LED that lights up if the outlet is improperly grounded. This can be an electrical danger and fire hazard if the outlet isn't using a ground-fault circuit interrupter (GFCI), a circuit breaker. If it's a normal outlet, has three prongs, and the Belkin lights up Not Grounded, I recommend contacting an electrician. Belkin notes in its warranty thatif the light appears and you can test the outlet is correctly grounded, it will provide a replacement.

Unlike many surge protectors, this model has no reset button. If the unit is tripped internally, you need to contact Belkin for assistance, and it has a limited lifetime warranty against defects and some kinds of damage.

For both product warranty service and to claim damages against the $25,000 connected equipment warranty that is part of the price of purchase, you must file a claim within 15 days. Information is available only in a nearly microscopically printed brochure included with the SurgePlus. The product and equipment warranty covers only the original purchaser.

Belkin SurgePlus USB Wall Mount

PROS

- Densely packed outlets.
- Well-placed USB ports.

CONS

- Outlets will be too close together for some AC adapters.
- USB ports underpowered for fast charging.

PRICE

$18

COMPANY

Belkin

BOTTOM LINE

The Belkin SurgePlus is the perfect addition to any cramped space or outlet located above floor level, such as adjacent to a countertop, where it can allow easy access and USB charging. (If you're mounting in a kitchen, make sure a thick backsplash won't get in the way.) ■

SOLID-STATE DRIVE

OWC ENVOY PRO EX USB-C: A FAST, VAST, AND TOUGH EXTERNAL SSD

BY BY JON L. JACOBI

Macworld EDITORS' CHOICE

The Envoy Pro EX USB-C is one of those products that actually lives up to the "Pro" in its moniker. Available in up to 4TB, it has twice the capacity of the current competition, and also just happens to be a hair faster. The pièce de résistance is IP67 (Ingress Protection) certification, meaning the drive can survive 30 minutes under 3.3 feet of water. That's sweet, though we don't recommend you put that to the test.

USB-C

USB Type-C, or USB-C (same thing, new name), is a physical connector employed by both Thunderbolt 3 and USB. It's not

IMAGE: BELKIN

indicative of the protocol being used, which in this case is SuperSpeed USB 10gbps (nee USB 3.x Gen 2). The Thunderbolt 3 Envoy Pro EX uses a USB-C connector, if you get my drift.

This is the Type-C port on one end of the Envoy Pro EX.

You'll likely understand what OWC means by USB-C, but Thunderbolt 3 compatibility is mentioned. In this case, that means you can connect the Envoy EX USB-C to a Type-C port (what it should be called) with the lightning icon, but it will use the USB protocol, not Thunderbolt.

Note that there's a third Envoy Pro EX USB 3 model with an older Micro-B SuperSpeed connector that is SuperSpeed USB 5Gbps (USB 3.x Gen 1). If you want the info on the latest attempt to straighten out the rat's nest of a naming convention that is USB straight from the horse's mouth, click here (go.macworld.com/1nfo). Back to the review.

DESIGN AND FEATURES

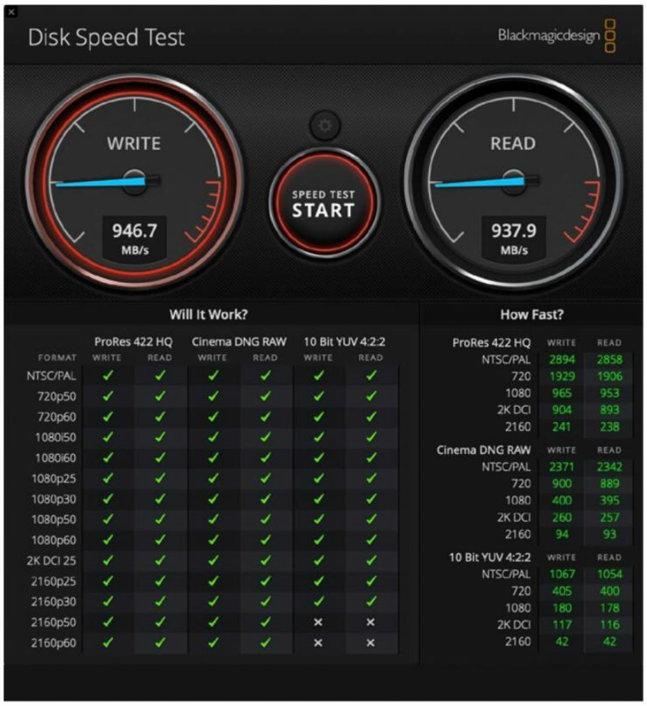
The secret to the Envoy Pro EX USB-C's large capacity is that it houses one of the first 4TB M.2 NVMe SSDs to hit the market—the Aura P12 (go.macworld.com/ar12). It's also available from OWC as a bare SSD for internal use.

At $1100, the 4TB Envoy Pro EX USB-C is hardly cheap, but considering its bleeding edge capacity, and that the bare Aura P12 is over $1000, that's really not bad. If you need it, you need it. On the other hand, there are less expensive options at $119 (240GB), $170 (480GB), $249 (1TB), and $479 (2TB). You can also purchase the enclosure unpopulated (no drive) for $60, if you want to roll your own.

The roll-your-own option might save you a few bucks if you opt for a bargain basement drive, but OWC isn't charging all the much more per gigabyte, and the Aura P12 seems to be a nice solid performer that, again, is really not that expensive. That said, 1GBps is about all you'll ever see from any SuperSpeed 10Gbps device in the real world, so just about any NVMe SSD is workable with small data sets.

The Envoy Pro EX USB-C is a good-looking, light silver drive that matches the

Apple-style minimalism dictates that only an activity light disrupt the smooth countenance of the Envoy Pro EX.



Will It Work?

	ProRes 422 HQ		Cinema DNG RAW		10 Bit YUV 4:2:2	
FORMAT	WRITE	READ	WRITE	READ	WRITE	READ
NTSC/PAL	✓	✓	✓	✓	✓	✓
720p50	✓	✓	✓	✓	✓	✓
720p60	✓	✓	✓	✓	✓	✓
1080i50	✓	✓	✓	✓	✓	✓
1080i60	✓	✓	✓	✓	✓	✓
1080p25	✓	✓	✓	✓	✓	✓
1080p30	✓	✓	✓	✓	✓	✓
1080p50	✓	✓	✓	✓	✓	✓
1080p60	✓	✓	✓	✓	✓	✓
2K DCI 25	✓	✓	✓	✓	✓	✓
2160p25	✓	✓	✓	✓	✓	✓
2160p30	✓	✓	✓	✓	✓	✓
2160p50	✓	✓	✓	✓	×	×
2160p60	✓	✓	✓	✓	×	×

How Fast?

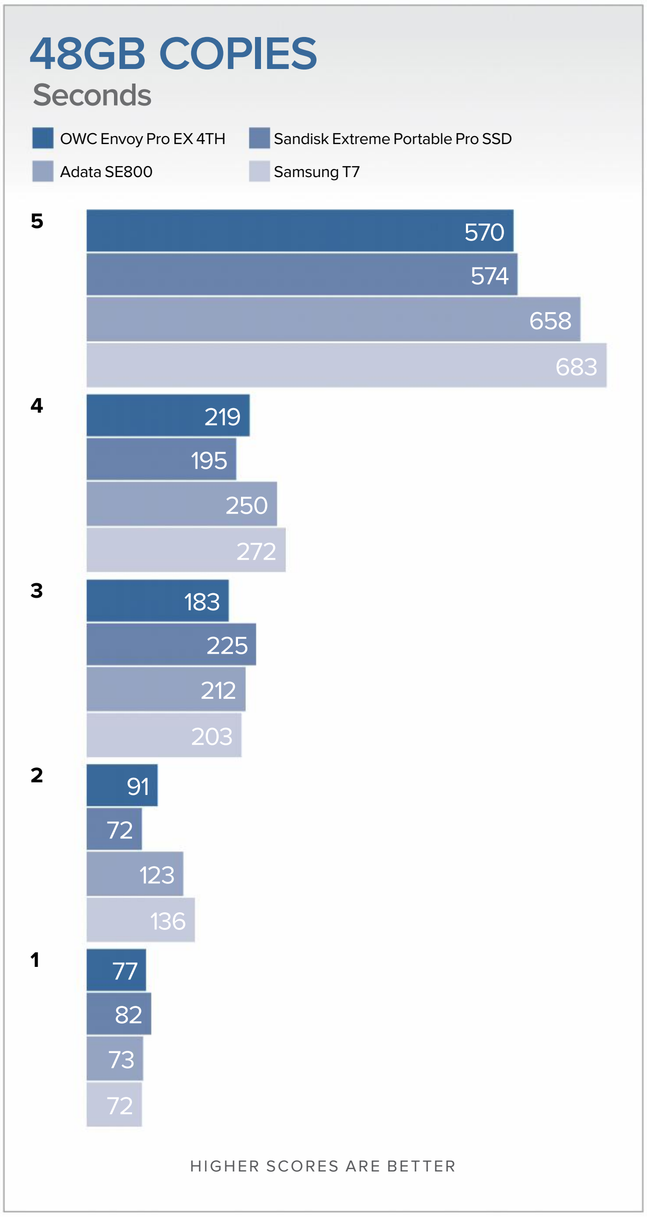
ProRes 422 HQ	WRITE	READ
NTSC/PAL	2894	2858
720	1929	1906
1080	965	953
2K DCI	904	893
2160	241	238
Cinema DNG RAW	WRITE	READ
NTSC/PAL	2371	2342
720	900	889
1080	400	395
2K DCI	260	257
2160	94	93
10 Bit YUV 4:2:2	WRITE	READ
NTSC/PAL	1067	1054
720	405	400
1080	180	178
2K DCI	117	116
2160	42	42

The Envoy Pro EX USB-C moves data right along, though it was a little slower operating off of a MacBook than a Windows PC.

aesthetics of most Macs. It's 2.6-inches wide, 4.5-inches long, and 0.4-inches thick with a Type-C port on one end, and an activity light on the other. As I mentioned, it's IP67 certified, meaning it's sealed against both dust and water. If you want to know more about IP (Ingress Protection) ratings, check out this TechHive article (go.macworld.com/iprt). The only other IP67-rated external SSD we are aware of is Adata's SE800. (go.macworld.com/se80)

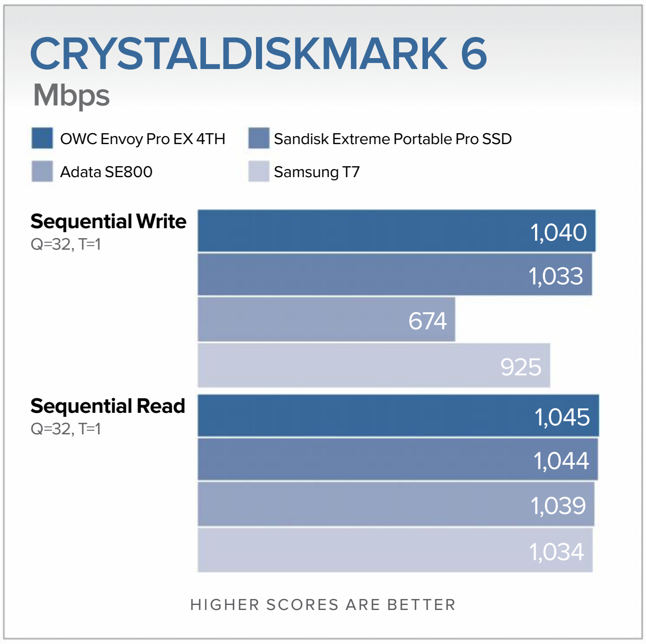
PERFORMANCE

The OWC Envoy Pro EX USB-C is the fastest SuperSpeed 10Gbps SSD that we've tested, albeit by only a gnat's eyebrow over the SanDisk Extreme Portable Pro SSD. It could have gone either way, but a victory is a victory, and this one belongs to the Envoy Pro EX USB-C.



Once again, the Envoy Pro EX narrowly defeated the reigning champion SanDisk Extreme Portable Pro SSD.

CrystalDiskMark 6 under Windows



It was uber close, but the Envoy Pro EX took the top spot in CrystalDiskMark compared to other USB 3.1 Gen 2 drives (SuperSpeed USB 10Gbps).

showed a slight advantage for the OWC over the SanDisk, with others trailing by a ways.

In the 48GB transfer tests, it was much the same story, with the OWC and SanDisk running neck and neck, with the others lagging slightly behind in most tests.

The margins are victory were slight, but we can still say with confidence that the Envoy Pro EX is as fast as it gets in a USB 3.1 Gen 2 (SuperSpeed USB 10Gbps) SSD.

Note that the lower capacity variants might not offer the same level of write performance. We didn't have them to test, so that's not fact, but a caveat based on past experience.

How we tested: We used a 15-inch 2018 MacBook Pro with a 2.9GHz Core i9 processor, 32GB of memory, a 2TB SSD, and 4GB Radeon Pro 560X graphics using Blackmagic's Disk Speed Test. Additional tests were run on a Windows 10 64-bit PC using a Core i7-5820K/Asus X99 Deluxe motherboard with four 16GB Kingston 2666MHz DDR4 modules, a Zotac (Nvidia) GT 710 1GB x2 PCIe graphics card, and an Asmedia ASM2142 USB 3.1 Gen 2 (10Gbps) card. Also on board are a Gigabyte GC-Alpine Thunderbolt 3 card and Softperfect's Ramdisk 3.4.6, which is used for the 48GB read and write tests.

Envoy Pro EX with USB C portable SSD

PROS

- Up to 4TB of capacity
- Excellent burst and sustained performance.
- IP67 rated (weather and dust resistant)

CONS

- Pricey at the 4TB level
- Confusing info on Web site.

PRICE

$199

COMPANY

OWC

BOTTOM LINE

The Envoy Pro EX USB-C is the fastest external USB SSD we've tested to date, it's IP67 certified, and it offers 4TB of capacity in a form factor no larger than the 2TB competition. It's not even that expensive as far as these things go. So let's see if I can puzzle this out… Fastest, vastest, tough, and relatively affordable. How could I tell you not to buy it? ■

In 30 states, it's legal to fire, evict or deny service to LGBT people.

Get the facts at BeyondIDo.org

GILL FOUNDATION

ad COUNCIL

Hot Stuff

What we're raving about this month

SAMSUNG THE FRAME 4K UHD TV

samsung.com

Looking for the ultimate TV that doesn't appear to be a TV? Look no farther than "The Frame." It's a quantum-dot LCD styled to appear as a wall-hung picture frame that displays art when you're not watching video. It fits flush against the wall—the back is completely flat, with a recess where the included, shallow-profile wall mount is attached. The Frame delivers a very good picture, the Samsung Smart Hub user interface is one of the best in the industry, and it comes with a minimalist but effective and comfortable One Remote. —**JON L. JACOBI**

Hot Stuff

SAMSUNG JETBOT MOP

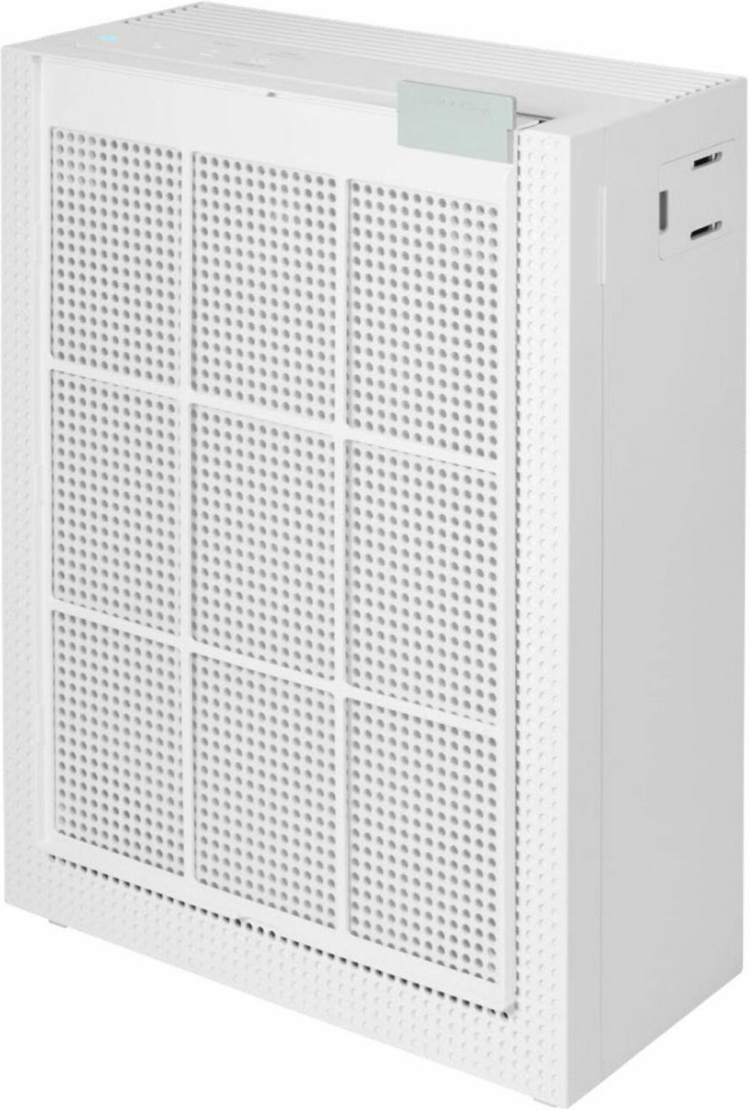
samsung.com

This 15-inch-wide robot uses two disc-shaped water reservoirs affixed with mopping pads to propel it across the floor as they scrub. And while most robot mops perform that single act, the Jetbot doubles as a handheld cleaner. Easy to operate and affordably priced, it's a compelling alternative to more sophisticated robot mops. The Jetbot doesn't have any room-mapping capability, so it cleans in a seemingly random pattern of straight, diagonal, and zig-zag movements using its smart sensors to avoid walls, furniture, and cliffs. Grab it by its handle and you can use it to clean bathtubs, shower tiles, windows, and other surfaces. **—MICHAEL ANSALDO**

COWAY AIRMEGA 150

cowaymega.com

Compact and low-key, the AIrmega 150 eschews smart tech for easy operation and a sub-$200 price tag and removes pollutants from your indoor air with minimal noise and fuss. It provides 214 square feet of coverage making it perfect for medium-sized rooms and small apartments. It has a Clean Air Delivery Rate (CADR) of 138 for smoke, 161 for dust, and 219 for pollen. These rates reflect the purifier's effectiveness in removing indoor the relative air pollutants based on room size and the volume of clean air produced per minute, with higher CADR numbers indicating increased effectiveness. **—JONATHAN TAKIFF**



END FAMILY FIRE
8 kids a day are accidentally killed or injured by **FAMILY FIRE.**
FAMILY FIRE is a shooting involving an improperly stored gun, often found in the home.
ENDFAMILYFIRE.org
Ad Council

MagSafe myths debunked: The truth about the iPhone 12’s new charging and accessory system

Speeds, strength, and everything else you need to know.

BY MICHAEL SIMON

MagSafe might be an old name to Apple veterans, but it has a whole new purpose. Apple slipped a brand new charging and modular accessory system into the iPhone 12, resurrecting the charging connector Apple retired when it switched to USB-C charging on the MacBook.

But since Apple isn’t including a MagSafe connector or even a compatible

IMAGE: MICHAEL SIMON

When you pop on the MagSafe charger, you get a nice animation on the front.

power adapter in the iPhone 12 box, you probably have some questions about MagSafe. And depending on where you find the answers, they might not be all that accurate. So forget about what you've read: Here's the truth about MagSafe.

MYTH: SPEEDS ARE TOO SLOW WITH A THIRD-PARTY CHARGER

REALITY: As long as it's 20W or higher, it doesn't really matter which charger you use

Charging is tricky. Depending on the phone you buy, there are several different protocols out there—QuickCharge, Warp Charge, Adaptive Fast Charging, etc.—but the most common is USB Power Delivery, which is what Apple uses.

But if you buy a MagSafe charger for $39, you'll need to bring your own power adapter, since Apple doesn't provide one with the iPhone 12 or the MagSafe cable. That's where things get a little tricky. MagSafe will charge the iPhone 12, 12 Pro, and 12 Pro Max at a maximum of 15W (only 12W for the iPhone 12 mini), but to get those speeds you'll need to use Apple's new 20W charger. Otherwise, you're going to get 12W charging.

That sounds worse than it actually is. I tested MagSafe with several chargers and MagSafe worked fine with all but one, Choetech's 100W charger. And while it's true that none of them charged quite as fast as Apple's 20W charger, they all filled up my iPhone at roughly the same pace.

Apple 20W Charger

HIGHEST: **17W**

BATTERY LIFE AFTER 10 MINUTES OF CHARGING: **12%**

Aukey 65W charger

HIGHEST: **12W**

BATTERY LIFE AFTER 10 MINUTES OF CHARGING: **11%**

Apple MacBook charger 60W

HIGHEST: **12W**

BATTERY LIFE AFTER 10 MINUTES OF CHARGING: **12%**

Anker PowerPort Atom III 60W

HIGHEST: **12W**

BATTERY LIFE AFTER 10 MINUTES OF CHARGING: **11%**

Samsung Fast Charger 40W

HIGHEST: **12W**

BATTERY LIFE AFTER 10 MINUTES OF CHARGING: **12%**

Ravpower 90W

HIGHEST: **11W**

BATTERY LIFE AFTER 10 MINUTES OF CHARGING: **12%**

You get the idea. Apple's charger might hit higher speeds and would probably win in a zero-to-100 test using the MagSafe charger, but it's not going to be a noticeable difference. With every charger I used, speeds slowed to under 10W once it reaches 50 percent charged when all of the chargers leveled off. So we're talking minutes at most.

MYTH: THE MAGSAFE CASES SNAP ON EASILY USING MAGNETS

REALITY: The cases are just as hard to remove as the iPhone 11 ones

I was somewhat mistaken when I ordered the clear MagSafe case with the ostentatious circular magnetic ring on the back. I was under the impression that the case served two purposes: bringing the MagSafe magnet to the back of the case for a stronger contact and connecting to the phone so the case could be easily removed.

Only one of those things is true. While the MagSafe adapter connects extremely well to the back of the MagSafe Clear case, which I tested, putting it on is just as difficult as the previous hard silicon case. Taking it off repeatedly leaves the same

Apple's new MagSafe clear case isn't very easy to put on.

compression creases in the bottom corners where the case needs to be forcefully pushed away from the phone, and the buttons are just as rigid as with previous clear cases.

The magnets on the MagSafe charger and case are plenty strong.

As it stands, your best bet is one of the silicone cases, though you'll cover up the color you choose for the iPhone 12. If you want a clear case, look for a very thin one, like Totalee's line of cases, which are available in frosted clear or fully transparent.

MYTH: THE MAGNETS AREN'T STRONG ENOUGH

REALITY: While the wallet attachment isn't ideal, the magnets are plenty strong for docks and mounts

While the MagSafe accessories Apple is selling are somewhat limited, the mechanism lends itself to all sorts of convenient uses. In my testing, the magnets are as strong as they need to be. When I attach the MagSafe charger to my refrigerator, for example, I need to pry it off, so the magnetic capabilities are there.

When using it with my iPhone 12, the charger is strong enough to stay attached to the back with a bit of jostling but will still detach when slightly pulled. The same goes for the wallet accessory, which won't fall off unless pushed off (though it can be accidentally detached when sliding into a pocket).

Once more accessories come out, I

The current crop of MagSafe accessories are only scratching the surface of what it can do.

think we'll see the magnetic strength increase as warranted. For example, a car vent mount will need to be stronger to keep the iPhone attached when driving over bumps and curves, and based on what MagSafe is capable of, they should be.

MYTH: MAGSAFE IS EXPENSIVE AND DOESN'T DO ANYTHING NEW

REALITY: MagSafe is expensive and doesn't do anything new yet

There's no denying that MagSafe is expensive and not all that worth it. Cases are $10 more than their iPhone 11 counterparts across the board, and the required charger costs $39 on its own without the required 20W USB-C power adapter. Add to that the $129 Duo Charger, $129 Leather Sleeve, and $59 Leather Wallet, and the cost of entry is definitely quite high.

But as with all things Apple, the early adopter tax will come down and the utility will go up. MagSafe does solve a persistent problem with wireless charging—making sure the proper contact has been made before walking away—and third-party car mounts, cables, and docks are already on the way. Granted it's entirely possible MagSafe never takes off and quietly goes away with the iPhone 15, but I'm willing to bet it's going to be a success. ■

This is how mind-blowingly fast 5G on the iPhone 12 can be

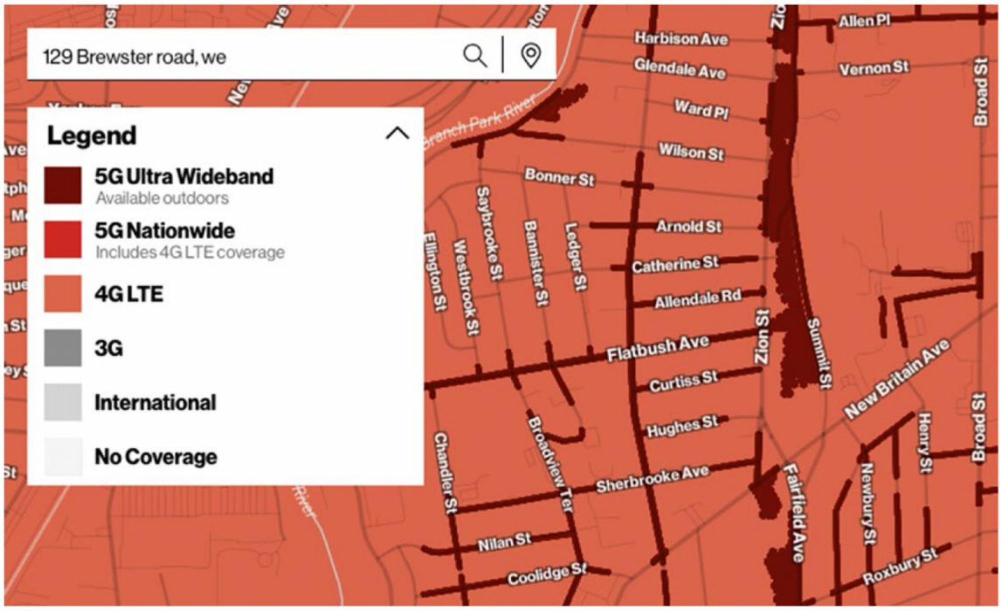
But it's not worth paying for just yet.

BY MICHAEL SIMON

If you've seen an ad for Apple's new iPhone 12 (go.macworld.com/12rv), you've probably heard that it supports 5G. The next-generation wireless networks promise incredibly fast downloads and uploads wherever you are, and if you subscribe to the right plan and live in the right place you'll be able to enjoy it on any of the four major carriers.

But even if you opt for a pricey unlimited plan that includes 5G, the speeds you get might not be all you hoped for. That's because there are two different kinds of 5G: sub-6GHz or "nationwide" 5G, and millimeter-wave or Ultra-Wideband 5G. In short: nationwide

IMAGE: MICHAEL SIMON


129 Brewster road, we
Legend
5G Ultra Wideband
Available outdoors
5G Nationwide
Includes 4G LTE coverage
4G LTE
3G
International
No Coverage
Harbison Ave
Glendale Ave
Ward Pl
Wilson St
Bonner St
Arnold St
Catherine St
Allendale Rd
Flatbush Ave
Curtiss St
Hughes St
Sherbrooke Ave
Nilan St
Coolidge St
Allen Pl
Vernon St
Broad St
Zion St
Summit St
New Britain Ave
Henry St
Newbury St
Fairfield Ave
Roxbury St
Saybrooke St
Westbrook St
Ellington St
Banister St
Ledger St
Chandler St
Broadview Ter
Branch Park River

Verizon has a handy UWB hotspot right near my house in Connecticut.

5G is a little faster than LTE and Ultra-WideBand is ridiculously fast.

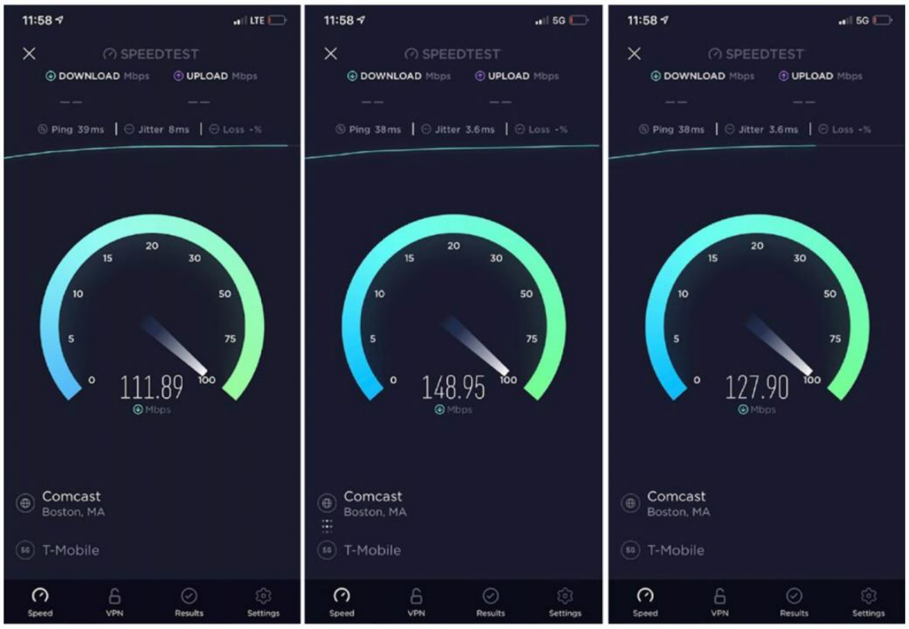
I tested two networks: T-Mobile/Sprint and Verizon. Verizon, T-Mobile and Sprint subscribers all get access to the broadest nationwide plan, with a million square miles of coverage that reach hundreds of millions of people. If you live in a coverage area, you'll get a decent speed boost, but depending on how strong the 4G LTE network is, it probably won't be all that noticeable without running a speed test app, which is exactly what I did.

Based on the map, T-Mobile's 5G network is a bit broader than Verizon's. For example, the entire state of Connecticut, where I live, is LTE-only for the most part with the fortunate exception of a small UWB area near my house. T-Mobile offers no UWB component to its 5G network yet.

Of course, your mileage will vary, but when using T-Mobile's 4G LTE network at my home in West Hartford, Conn., I got a top download speed of around 110Mbps, which is already much higher than T-Mobile's national average speed of about 25Mbps. When I switched to 5G, that increased to roughly 150Mbps, an impressive jump for sure, but nothing that's going to fundamentally change the way I use my phone.

You can probably expect speeds that are better than what you'll get over LTE, sometimes significantly so. For example, my colleague Jason Cross got better than 50Mbps when connected to 5G versus just 15Mbps over LTE. Again, that's a far cry from the multi-gig, download-movies-in-seconds promise of 5G, but it's a nice boost.

The good thing is if you're a T-Mobile or Sprint customer you already have access to their 5G network. The carrier includes 5G coverage on all three of its plans (Essentials, Magenta, and Magenta Plus) at no extra cost, so you'll automatically enjoy faster speeds without needing to shell out any extra cash.


11:58
LTE
SPEEDTEST
DOWNLOAD Mbps
UPLOAD Mbps
Ping 39ms
Jitter 8ms
Loss -%
0
5
10
15
20
30
50
75
100
111.89
Mbps
Comcast
Boston, MA
T-Mobile
Speed
VPN
Results
Settings
11:58
5G
SPEEDTEST
Ping 38ms
Jitter 3.6ms
Loss -%
148.95
Mbps
Comcast
Boston, MA
T-Mobile
11:58
5G
SPEEDTEST
Ping 38ms
Jitter 3.6ms
Loss -%
127.90
Mbps
Comcast
Boston, MA
T-Mobile

T-Mobile's nationwide 5G network is quite good, but not game-changing.

ULTRA LIVES UP TO ITS NAME

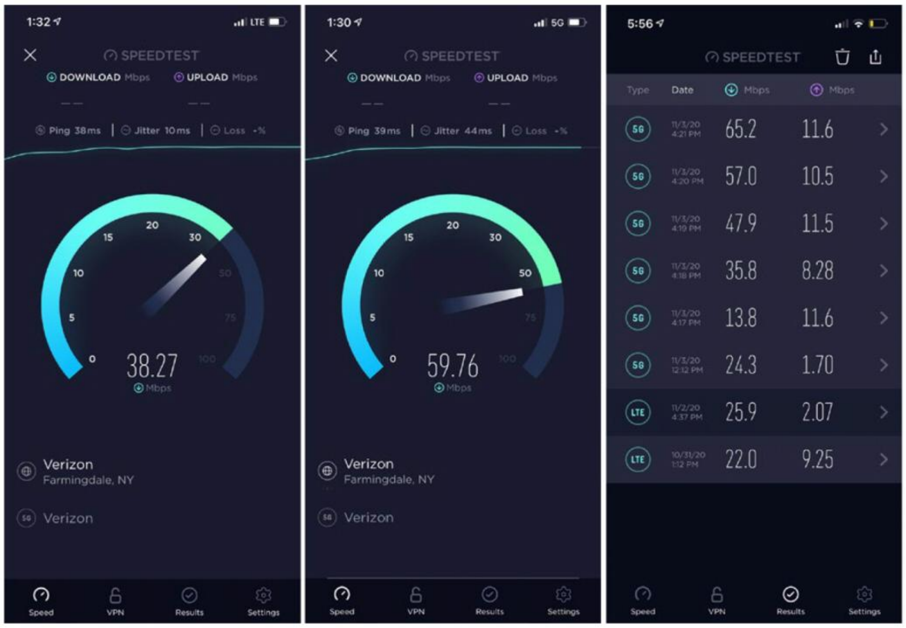
5G on Verizon is a different story. While anyone with a Verizon plan will see a 5G icon on their iPhone when they're within a coverage area, most people won't get the speediest version of it.

As announced at the iPhone 12 launch event, Verizon now offers a sub-6GHz nationwide plan. Like T-Mobile, it is available to all subscribers at no additional cost, even if you don't have an unlimited plan. As long as you have a Verizon plan and live within one of the 5G coverage areas, you'll be able to use the next-gen network. Unlike T-Mobile's network, however, Verizon is using its existing 4G bands to create its nationwide 5G network, so speeds won't be quite as fast and probably won't be all that much faster than 4G LTE.

As I said, my home state of Connecticut isn't included in the nationwide coverage map yet, so I couldn't test it here. However, my dad lives in Levittown, N.Y., one of Verizon's brightest nationwide 5G areas, so he was able to test it with his own iPhone 12. When connected to 5G, he reached speeds that topped 60Mbps and averaged around 50Mbps, faster than his usual LTE average of about 40Mbps. That's not a speed gain that you'll notice in day-to-day use, but it's still a nice boost over the iPhone 11's LTE speeds, especially for free.

If you pay for one of the top-tier unlimited plans, however, you'll get access to Verizon's Ultra Wideband mmWave network, which will deliver the fastest possible speeds, provided you live near one. They're limited to just 55 cities and even within those locations, it covers just a few miles. And even then, mmWave signals are easily blocked by walls, windows, and even people.

But if you can lock in on a signal, Verizon's UWB network is quite spectacular. I was able to test the 5G UWB network in Hartford and I was blown away by the speeds it delivered. At peak speeds, I


1:32
LTE
SPEEDTEST
DOWNLOAD Mbps
UPLOAD Mbps
Ping 38ms | Jitter 10ms | Loss -%
38.27
Mbps
Verizon
Farmingdale, NY
Verizon
1:30
5G
SPEEDTEST
DOWNLOAD Mbps
UPLOAD Mbps
Ping 39ms | Jitter 44ms | Loss -%
59.76
Mbps
Verizon
Farmingdale, NY
Verizon
5:56
SPEEDTEST
Speed
VPN
Results
Settings

Type	Date	Mbps	Mbps
5G	11/3/20 4:21 PM	65.2	11.6
5G	11/3/20 4:20 PM	57.0	10.5
5G	11/3/20 4:19 PM	47.9	11.5
5G	11/3/20 4:18 PM	35.8	8.28
5G	11/3/20 4:17 PM	13.8	11.6
5G	11/3/20 12:12 PM	24.3	1.70
LTE	11/2/20 4:37 PM	25.9	2.07
LTE	10/31/20 1:12 PM	22.0	9.25

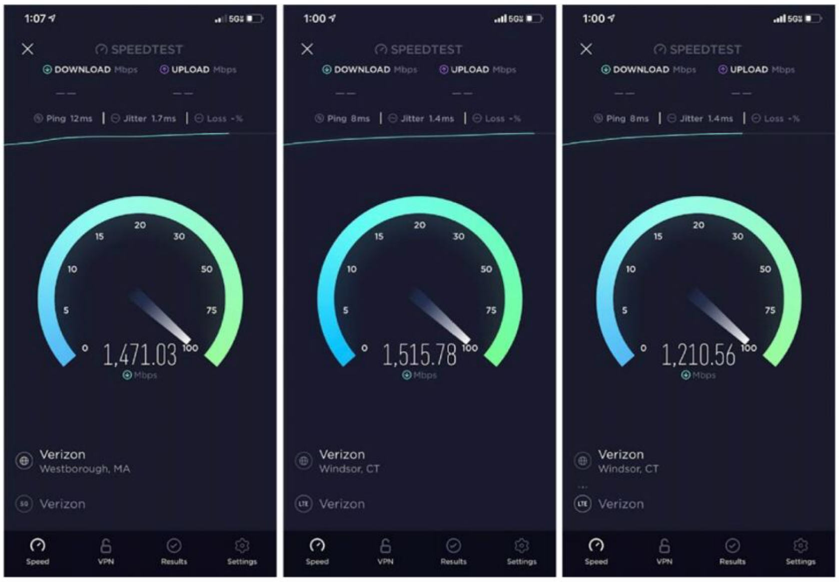
Verizon's Nationwide 5G network is only slightly better than LTE.

topped 1.5Gbps download and better than 50Mbps upload, both substantially better than even the gigabit internet at my house.

Even while riding in a car (in a passenger seat of course), I was able to sustain around 300MBps for about a mile, and when I stopped, speeds instantly jumped to a gig-plus. With the windows rolled up, I still approached 1Gbps in most places I stopped. When I was on the edge of the network's reach, I was able to get impressive speeds above 200Mbps.

However, while those speeds are incredibly impressive, I wouldn't recommend jumping at one of the pricey unlimited plans, which start at $80 a month for one line and top out at $180 a month for four lines. Even though the coverage in the Frog Hollow neighborhood of Hartford was better than the network I tested last year in Providence (go.macworld.com/12rv), it's still a far cry from being as useable as nationwide 5G or LTE.

As it stands, you'll need to pick out specific areas to do your downloading, and it's most useful as a way to show off what your iPhone can do rather than actually doing anything with it. Still though, it's pretty amazing. ■


1:07
5G
SPEEDTEST
DOWNLOAD Mbps
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Ping 12ms | Jitter 1.7ms | Loss -%
1,471.03
Mbps
Verizon
Westborough, MA
Verizon
1:00
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SPEEDTEST
DOWNLOAD Mbps
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Ping 8ms | Jitter 1.4ms | Loss -%
1,515.78
Mbps
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DOWNLOAD Mbps
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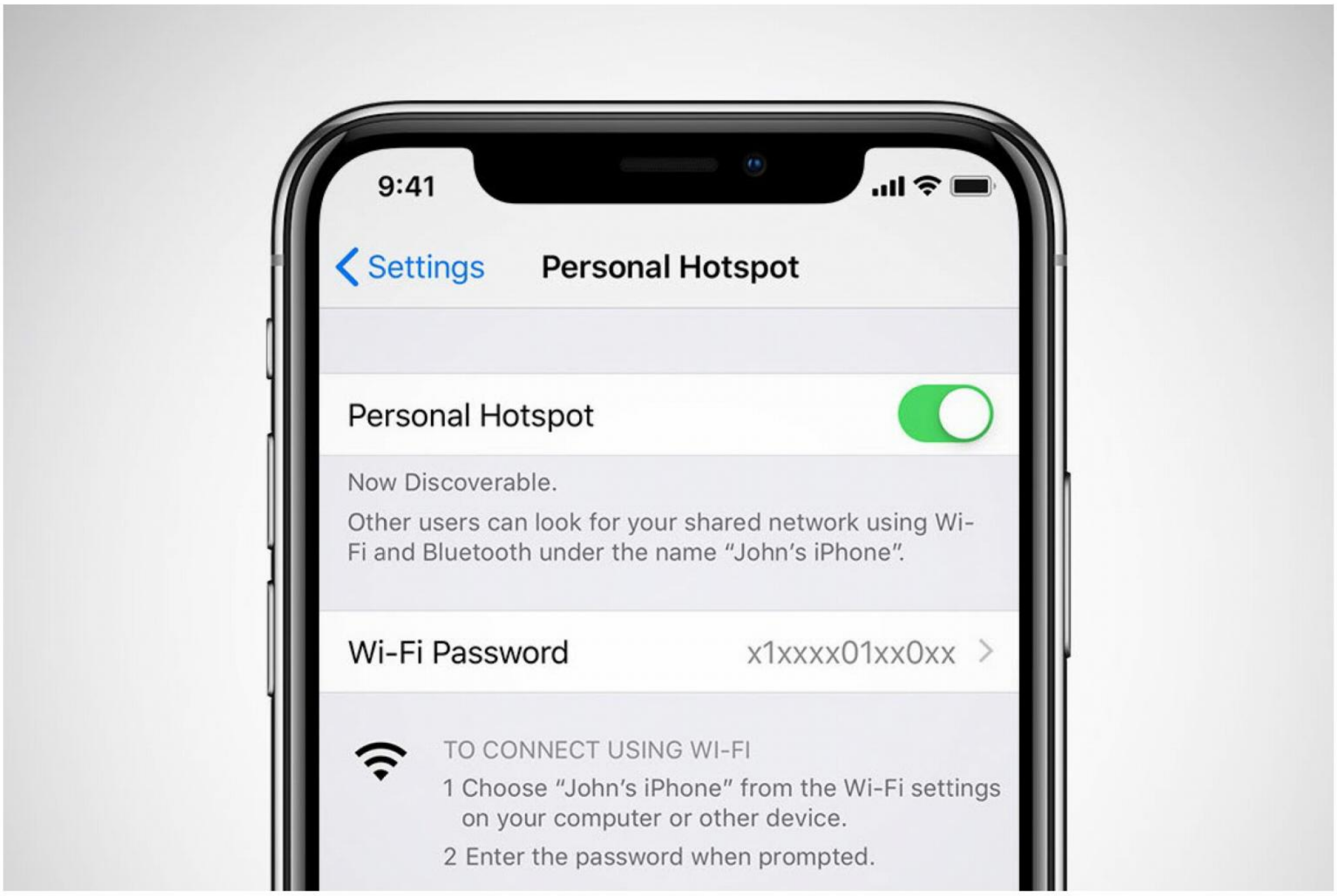
1,210.56
Mbps
Verizon
Windsor, CT
Verizon
Speed
VPN
Results
Settings

Speeds on Verizon's UWB network are mind-blowingly fast when you get them.

How to share your iPhone’s mobile connection by tethering or hotspot

If you need Wi-Fi on your Mac or iPad, you can share your iPhone’s mobile data.

BY MICHAEL SIMON



Personal Hotspot

Now Discoverable.

Other users can look for your shared network using Wi-Fi and Bluetooth under the name “John’s iPhone”.

Wi-Fi Password x1xxxx01xx0xx

TO CONNECT USING WI-FI

1 Choose “John’s iPhone” from the Wi-Fi settings on your computer or other device.

2 Enter the password when prompted.

Apple might not make a MacBook that has an LTE chip inside it yet, but that doesn’t mean you can’t deliver Wi-Fi to your laptop when you need it. As long as you have an iPhone handy, you can easily and securely share your connection with your MacBook or iPad in a pinch.

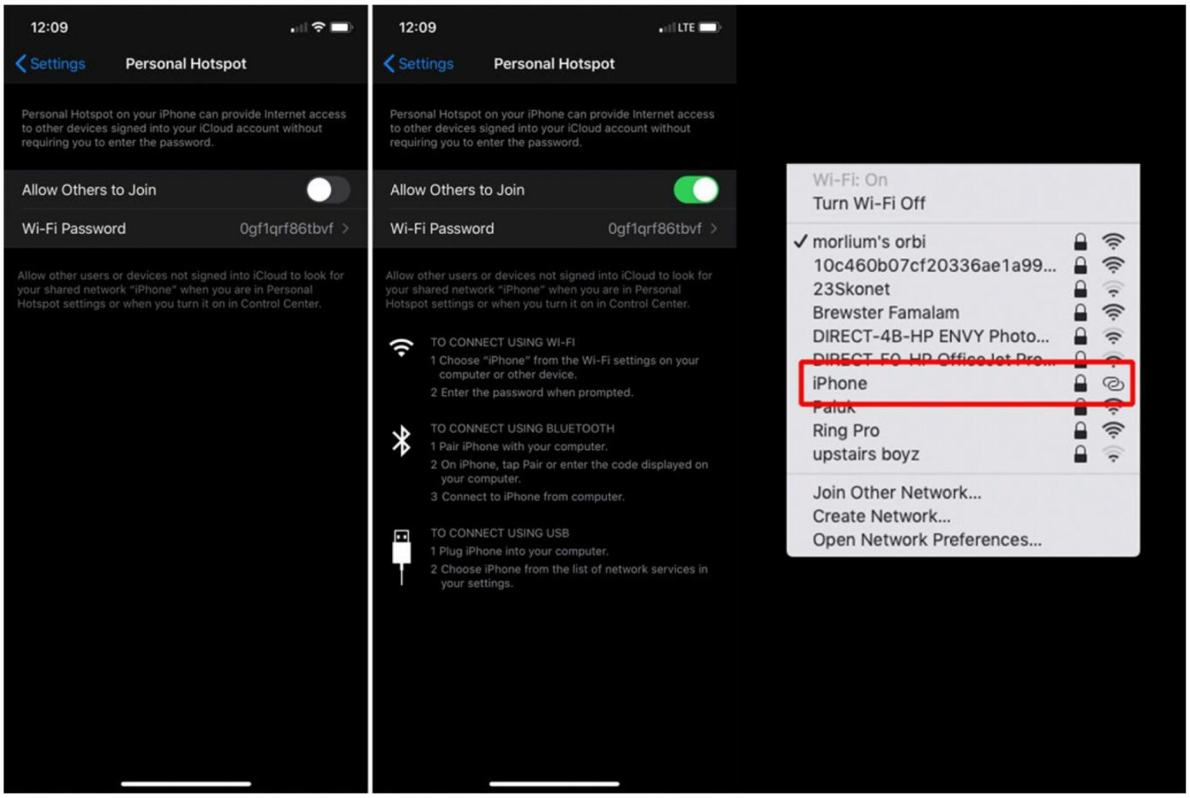
If your Apple devices are signed into the same iCloud account, connecting is as easy as choosing your iPhone’s name in the Wi-Fi list. Click on the Wi-Fi symbol in the status bar or head to the Wi-Fi settings on your iPad, and you’ll see a Personal Hotspot section. Tap the name of your iPhone and voila, you’ll be connected without needing to enter a password.

If you're using a POC or a Chromebook or sharing to someone else's iPad or Mac, you'll need to broadcast your network. Head over to the Settings app on your iPhone and tap on the Personal Hotspot tab. Then, flip the Allow Others to Join toggle to blue, which will display your password. Then choose your iPhone's wireless name on your other device, type in the password, and you'll be connected.

You can also tether your iPhone via Bluetooth or USB for a more personal network, though those methods will be a bit slower. To connect over Bluetooth, you'll need to pair your iPhone with the other device and then connect to the Bluetooth PAN network. Similarly, to connect over USB, connect your iPhone to the other device using a Lightning-to-USB cable and connect to the device directly in the network preferences.

When you're finished using the network, you can simply disconnect on the other device and if you're sharing it with others, turn off the personal hotspot on your iPhone.

Of course, since you'll technically be using your iPhone's mobile data, be mindful of what you're doing while connected. E-mail and web surfing will be fine, but if you plan on downloading files and streaming movies, you'll want to keep an eye on how much data you're using. ■


12:09
Settings
Personal Hotspot

Personal Hotspot on your iPhone can provide Internet access to other devices signed into your iCloud account without requiring you to enter the password.

Allow Others to Join ○

Wi-Fi Password 0gf1qrf86tbvf

Allow other users or devices not signed into iCloud to look for your shared network "iPhone" when you are in Personal Hotspot settings or when you turn it on in Control Center.

12:09
LTE
Settings
Personal Hotspot

Personal Hotspot on your iPhone can provide Internet access to other devices signed into your iCloud account without requiring you to enter the password.

Allow Others to Join ●

Wi-Fi Password 0gf1qrf86tbvf

Allow other users or devices not signed into iCloud to look for your shared network "iPhone" when you are in Personal Hotspot settings or when you turn it on in Control Center.

TO CONNECT USING WI-FI
1 Choose "iPhone" from the Wi-Fi settings on your computer or other device.
2 Enter the password when prompted.

TO CONNECT USING BLUETOOTH
1 Pair iPhone with your computer.
2 On iPhone, tap Pair or enter the code displayed on your computer.
3 Connect to iPhone from computer.

TO CONNECT USING USB
1 Plug iPhone into your computer.
2 Choose iPhone from the list of network services in your settings.

Wi-Fi: On
Turn Wi-Fi Off
✓ morlium's orbi
10c460b07cf20336ae1a99...
23Skonet
Brewster Famalam
DIRECT-4B-HP ENVY Photo...
DIRECT-F0-HP OfficeJet Pro...
iPhone
Paluk
Ring Pro
upstairs boyz
Join Other Network...
Create Network...
Open Network Preferences...

When you allow others to join your personal hotspot, they'll see your phone's name in the Wi-Fi list but won't be able to join without a password.

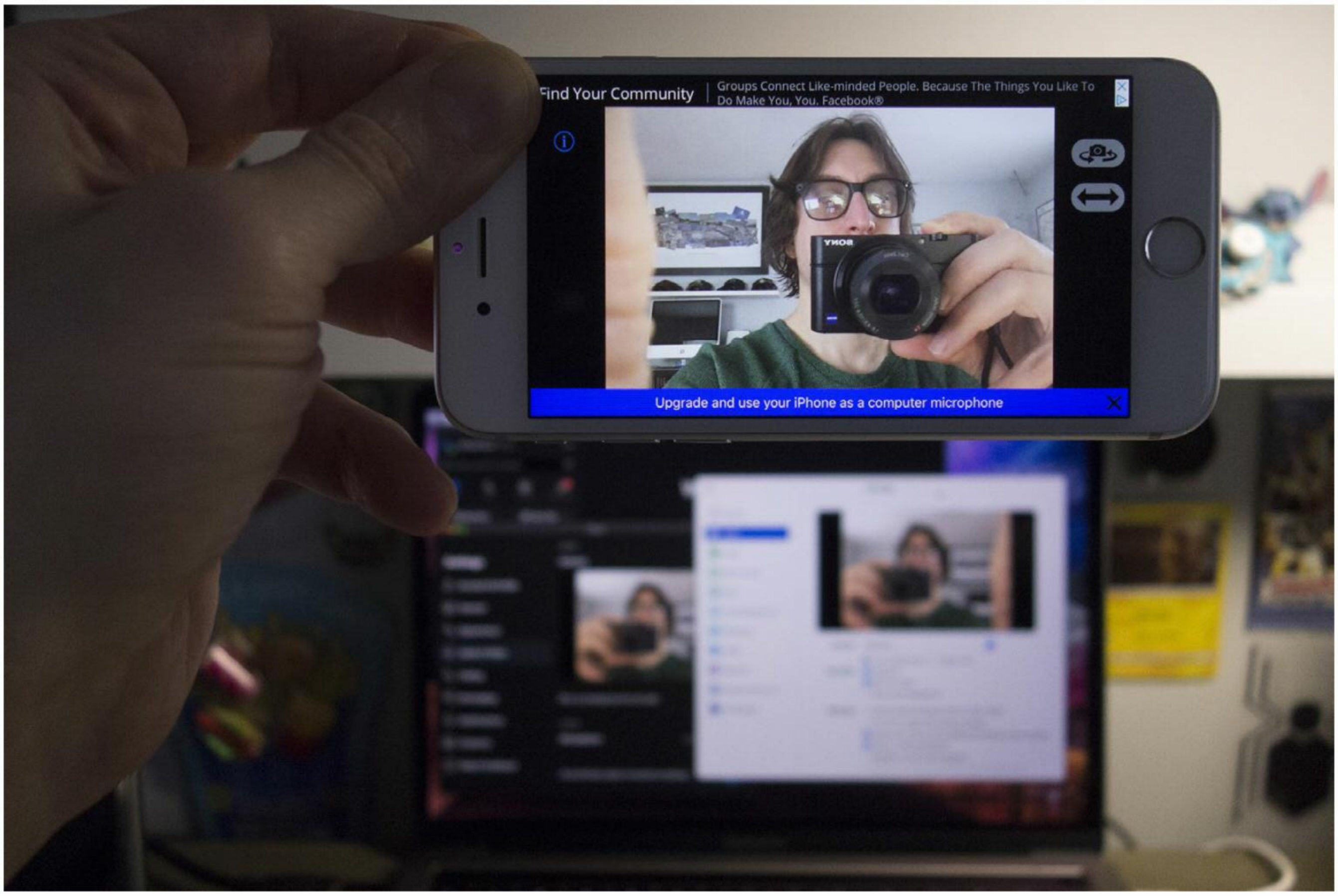

Find Your Community
Groups Connect Like-minded People. Because The Things You Like To Do Make You, You. Facebook®
Upgrade and use your iPhone as a computer microphone

IMAGE: MICHAEL SIMON

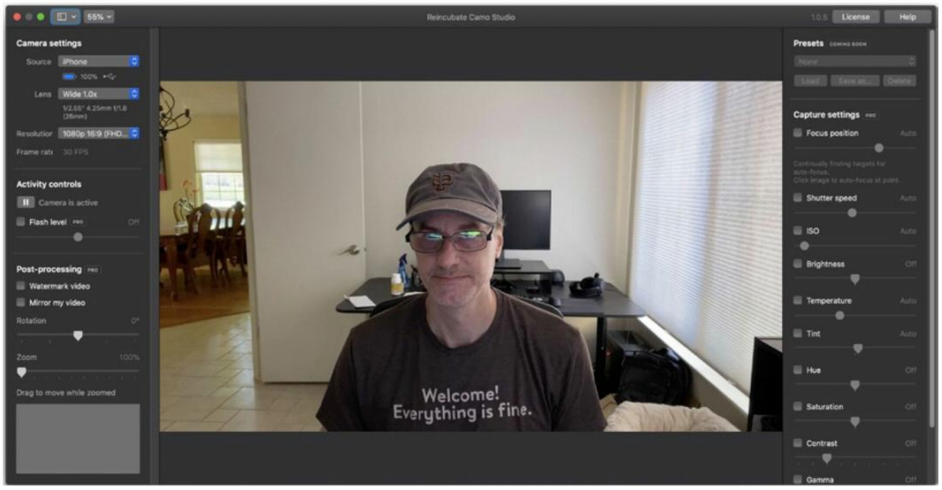
How to use your iPhone as a webcam for video conferencing and virtual meetings

Put your old iPhone to good use.

BY MICHAEL SIMON

Just because you're working from home now doesn't mean you're off the hook when it comes to meetings. And just because you don't have a spare webcam around doesn't mean you need to peel back the tape that's covering your laptop's camera—as long as you have an iPhone or an iPad, you can easily turn it into a makeshift webcam.

There are a few different apps you can use, but we recommend Kinoni's EpocCam

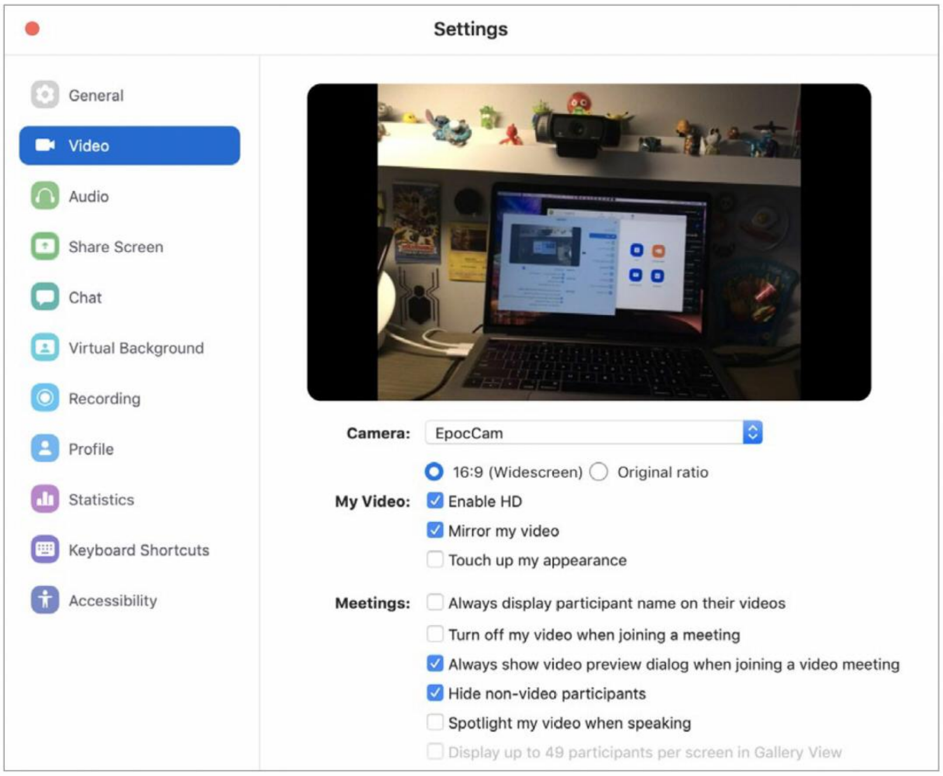

Reincubate Camo Studio
55%
1.0.5
License
Help
Camera settings
Activity controls
Post-processing PRO
Presets COMING SOON
Load
Save as...
Delete
Capture settings PRO
Drag to move while zoomed
Welcome!
Everything is fine.

Source: iPhone
100%
Lens: Wide 1.0x
1/2.55" 4.25mm f/1.8 (26mm)
Resolution: 1080p 16:9 (FHD...
Frame rate: 30 FPS
Camera is active
☐ Flash level PRO — Off
☐ Watermark video
☐ Mirror my video
Rotation: 0°
Zoom: 100%
Presets: None
☐ Focus position — Auto
Continually finding targets for auto-focus. Click image to auto-focus at point.
☐ Shutter speed — Auto
☐ ISO — Auto
☐ Brightness — Off
☐ Temperature — Auto
☐ Tint — Auto
☐ Hue — Off
☐ Saturation — Off
☐ Contrast — Off
☐ Gamma — Off

The Camo interface is simple with lots of useful controls.

Webcam. Not only is it easy to set up, but the free version with ads and occasional watermarking works with both Mac and PC (iVCam is a good option [go.macworld.com/ivcm] if you're using Windows, and NDI just made its $20 HX Camera app free for 60 days [go.macworld.com/hxcm]). Any iOS device that's running iOS 10.3 or later will work, so even if you have an old iPhone 5 or iPad mini 2 in a drawer, it'll work. If you're willing to pay, Camo works exceptionally well (go.macworld.com/cam0) and gives you lots of great options in an easy-to-use interface.

To get started, first download the EpocCam app (go.macworld.com/epoc) on your iPhone or iPad. Then head over to your Mac or PC and visit www.kinoni.com to download the driver for macOS (10.12 and later) or Windows (Windows 7 and later). Follow the steps to install and then restart your machine just to be sure it's recognized.


Settings
General
Video
Audio
Share Screen
Chat
Virtual Background
Recording
Profile
Statistics
Keyboard Shortcuts
Accessibility

Camera: EpocCam

My Video:
● 16:9 (Widescreen) ○ Original ratio
☑ Enable HD
☑ Mirror my video
☐ Touch up my appearance

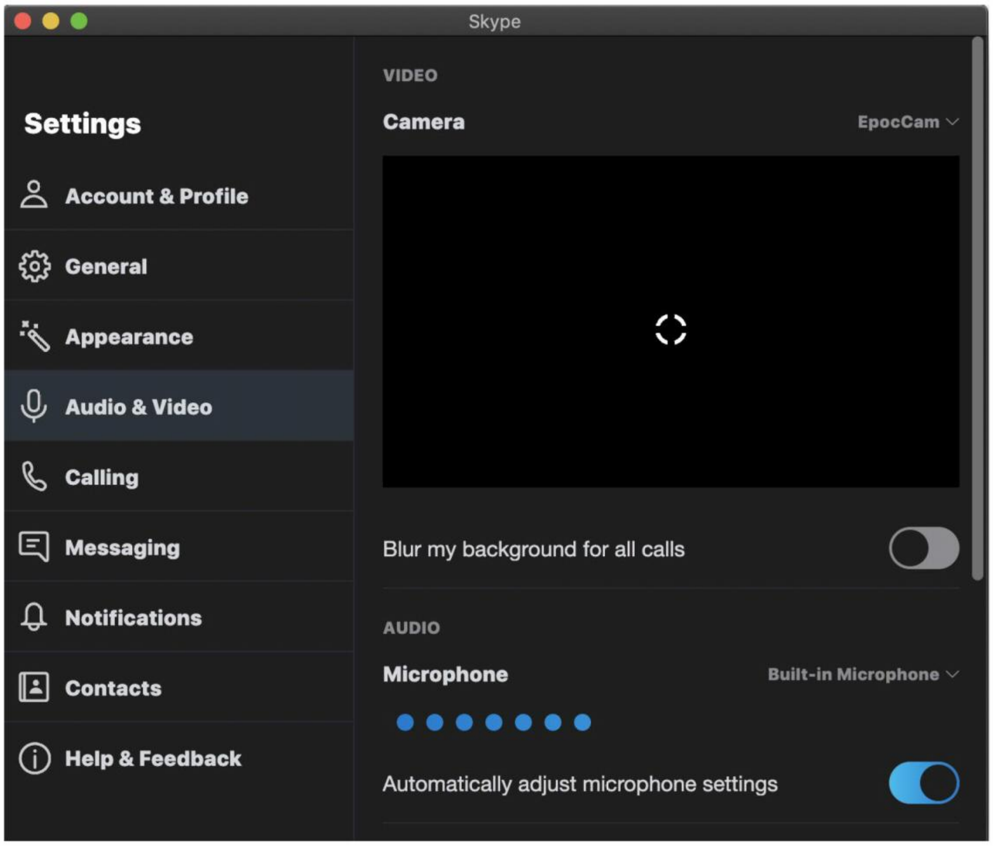
Meetings:
☐ Always display participant name on their videos
☐ Turn off my video when joining a meeting
☑ Always show video preview dialog when joining a video meeting
☑ Hide non-video participants
☐ Spotlight my video when speaking
☐ Display up to 49 participants per screen in Gallery View

EpocCam will appear as an option in Zoom's video settings.

Once you're up and running, go back to your iPhone and launch the EpocCam app. Don't be worried if all you see is a black screen with an image of a laptop and a phone pulsing circles—that means the app is searching for your computer. Once you launch an app on your computer that supports video, the EpocCam app will activate and bean video over Wi-Fi to your computer. For example, if you're using Skype, go to the Audio & Video settings, and select EpocCam from the drop-down menu above the video screen. You can use this Github site (go.macworld.com/ghsi) to test the connection; Mac users can also download the EpocCam Viewer for Mac (go.macworld.com/epvw) to test it.

If you're using the free version of EpocCam, the video will be limited to 640x480 at 30fps, but you can download EpocCam Webcamera for Computer for $8 to raise it to 1080p Full HD video. And if you're looking to run more than one stream simultaneously (as well as the same HD features as EpocCam Webcamera), EpocCam MultiCam is available for $20. However, you'll need a separate microphone, as EpocCam disables it on the iPhone while the camera is running.

A few troubleshooting tips: If EpocCam isn't listed as an option, try installing the driver again. If it still doesn't work, make sure your iPhone and computer are both connected to the same Wi-Fi network. Also, if you see a black screen with a spinning loading icon in the video window and the iPhone app is open, try quitting the apps on both your iPhone and computer and relaunching. If that doesn't fix it, try restarting your computer. ■



Camera EpocCam

Blur my background for all calls ○

Microphone Built-in Microphone

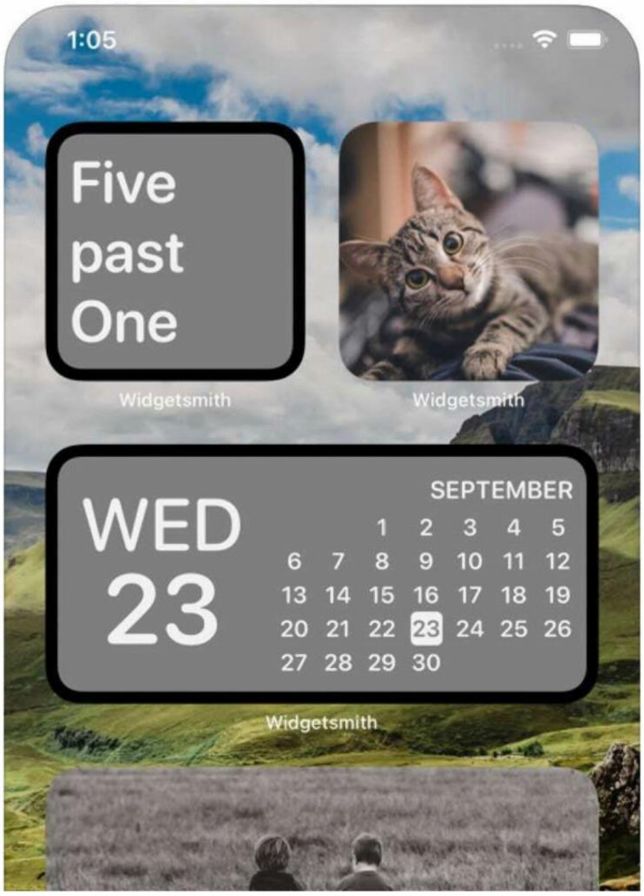
Automatically adjust microphone settings ●

If you don't see an image when you select the EpocCam, you probably just need to launch the app on your iPhone.

How Apple can take advantage of iPhone makeover mania

People upgrade for emojis. Why not for more customization features?

BY JASON SNELL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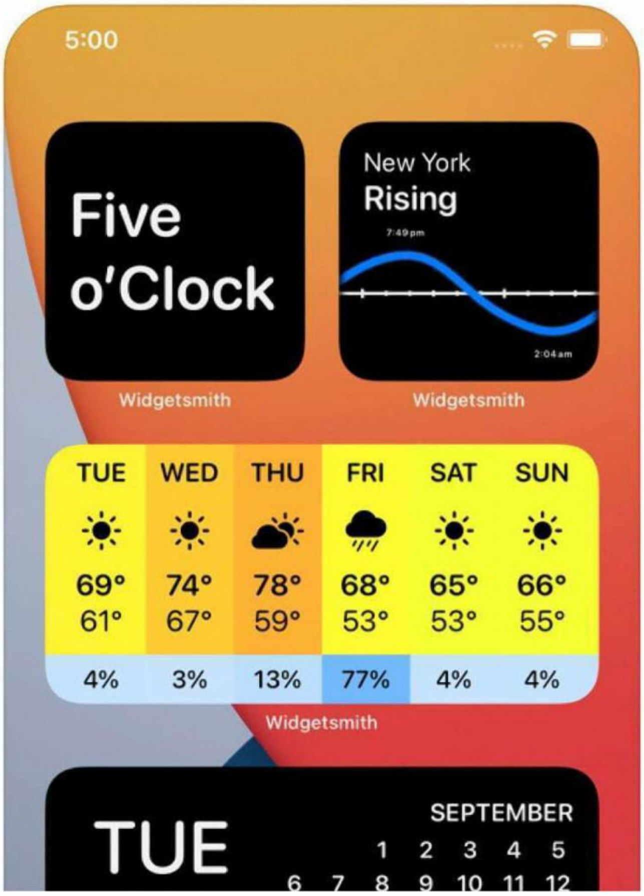

5:00
Five o'Clock
New York
Rising
7:49 pm
2:04 am
Widgetsmith
Widgetsmith
TUE WED THU FRI SAT SUN
69° 74° 78° 68° 65° 66°
61° 67° 59° 53° 53° 55°
4% 3% 13% 77% 4% 4%
Widgetsmith
TUE
SEPTEMBER
1 2 3 4 5
6 7 8 9 10 11 12

The people have spoken. Apps like Widgetsmith and (go.macworld.com/wism) Color Widgets (go.macworld.com/clwd) sit at the top of the App Store charts. iOS 14 has provided users with the ability to customize the look of their devices like never before.

Apple's not dumb. It has to be considering how it can take advantage of this trend. It's got a bunch of options, and I have a few ideas.

WHY SHOULD APPLE CARE?

Now, you may be saying to yourself, why does it matter to Apple that people are using iOS 14 widgets and custom shortcuts to make over their iPhones? These are trivialities and Apple should be focused on matters of substance.

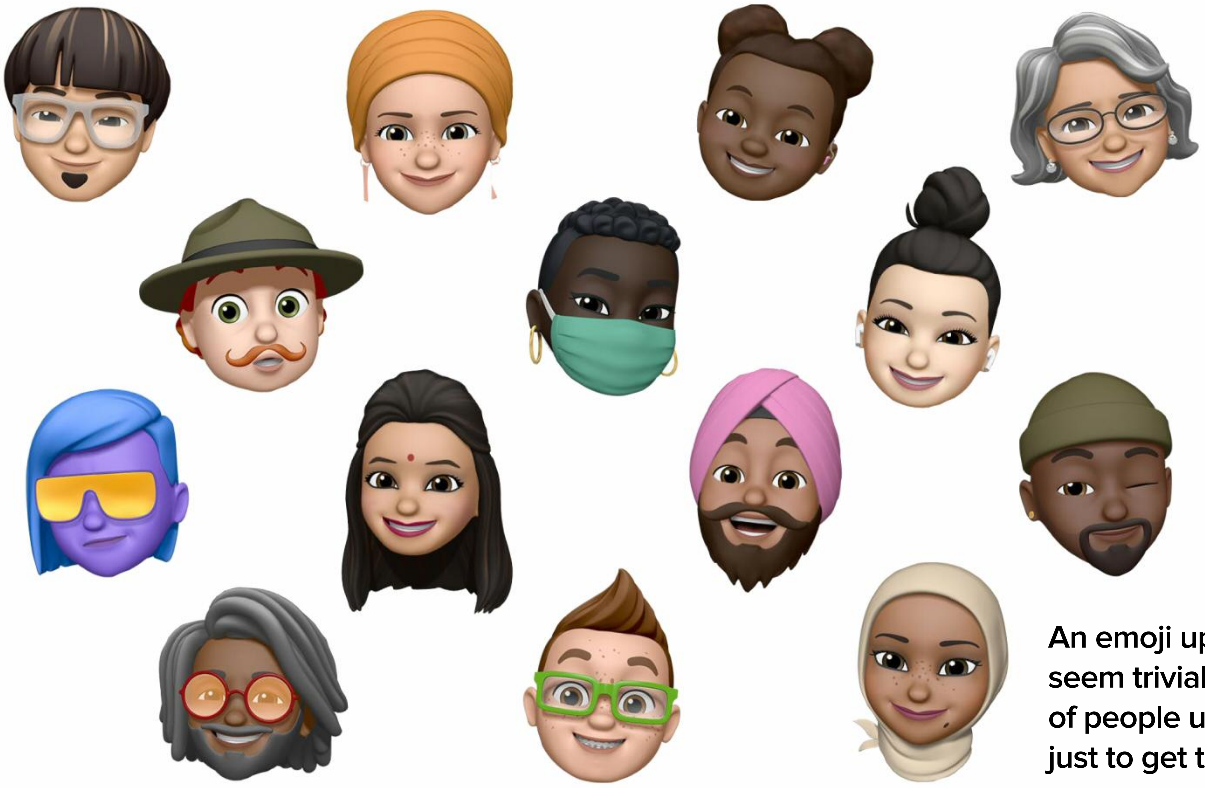
I've got news for you: What you consider a triviality, Apple considers an opportunity. Consider Apple's annual release of new emojis, which generally happens in the fall as a part of the point-one release of the newest version of iOS. Apple unveils the emojis in the summer on World Emoji Day, and makes a big deal out of the eventual iOS release, because it knows that people will update their phones so they can use (and see) the new emojis. It's a lever to drive adoption of the newest version of iOS, and that's important to Apple.

And in recent years, Apple has added other fun features to iOS and used them as additional motivators. New Animoji characters and new Memoji styles can potentially drive people to update their devices, too.

Not everyone is motivated by the latest and greatest operating-system productivity features. Apple wants everyone to update. Offering emojis and animojis and memojis are a way to do it. It turns out that adding other customization features might be another powerful tool for Apple to use.

GIVE THE USERS MORE CONTROL

What should Apple be focusing on in future software updates? To start, it needs



An emoji update may seem trivial, but a lot of people update iOS just to get them.

to give users more power and control over the look and feel of devices.

Take custom app icons. Right now you can build custom icons to make your iPhone beautiful, but only via an ugly workaround—namely, creating a single-step Shortcut that launches an app, and saving that Shortcut to the home screen with a custom icon. (Then you hide the real app in App Library.)

Currently, when you tap on that shortcut icon, it opens the Shortcuts app, then opens the app in question. I've seen some people suggest that Apple could make this process cleaner by eliminating that interim step. That's a fine suggestion, but it doesn't go far enough. Apple should let users do what they do on the Mac, and create custom icons for their apps and folders.

While we're at it, how about allowing users to change the text beneath their apps? Let users give those icons custom names, or even have the option of hiding their names entirely.

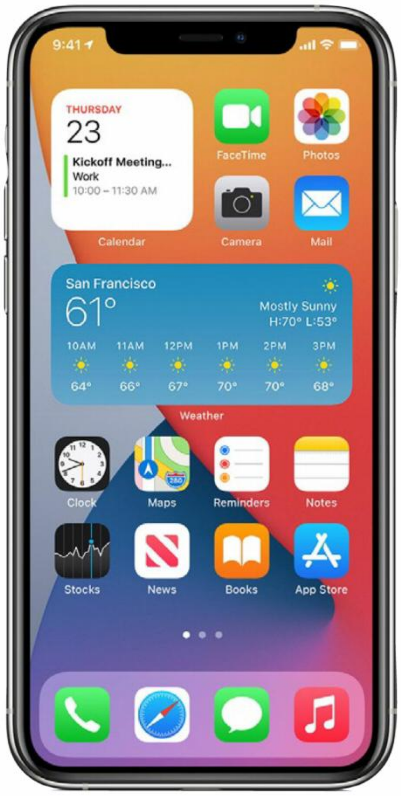
And most importantly, Apple needs to take Android's lead and allow the arbitrary placement of icons at any point on the home screen app grid, so users can place icons at the bottom of a page without requiring a bunch of icons at the top.

Now, some people will claim that many of these moves have potential security issues, and they do—but if the users are choosing to make these changes and are sufficiently warned, I think they're worth making anyway. Security is important—but insisting on not implementing any feature that could ever conceivably diminish security in any way is no way to live. Security can be maintained while giving users more freedom, and Apple needs to embrace that.

Currently, if you want to use custom icons, you are required to use the Shortcuts app.

PROVIDE MORE TOOLS FOR DEVELOPERS

But Apple can do more than just give more power directly to users. It can also empower developers to build more and better tools to give users even more of what they want. Apple's introduction of home screen widgets in iOS 14 isn't exactly what set off this trend—it was the apps that took advantage of that


9:41
THURSDAY
23
Kickoff Meeting...
Work
10:00 – 11:30 AM
Calendar
FaceTime
Photos
Camera
Mail
San Francisco
61°
Mostly Sunny
H:70° L:53°
10AM 11AM 12PM 1PM 2PM 3PM
64° 66° 67° 70° 70° 68°
Weather
Clock
Maps
Reminders
Notes
Stocks
News
Books
App Store

It's also clear that more widget features need to be on the agenda.

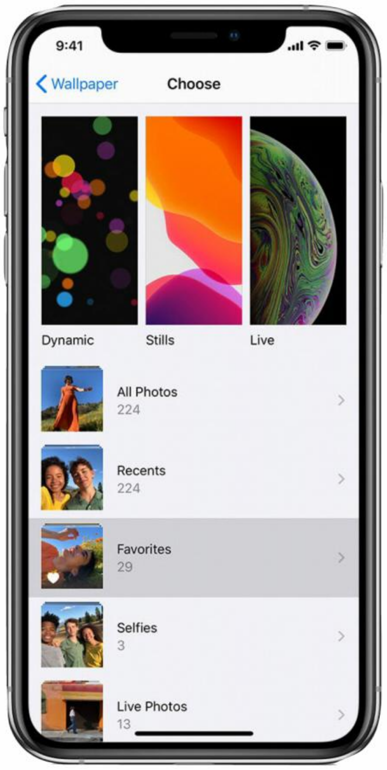
feature. Developers need to be part of the party, and they will come up with tricks that Apple never even considered.

Apple needs to seriously consider expanding its theme system beyond Light and Dark modes. Imagine a handful of official themes that users could choose from, and then every app on their device could adjust its appearance to reflect that theme. These themes could include color schemes and, yes, custom icons for every app. Consider it the logical extension of the custom background images that Apple builds for devices of different colors.

It's also crystal clear that more widget features need to be on the agenda. More widget options for developers is a start. I'd like to see widgets be more interactive, and with more ability to react to the current status of the device. Whatever Apple did to build the iOS 14 widgets interface, it worked—now do more.

Finally, Apple needs to consider what other approaches it could take that would add more fun to iOS. More dynamic wallpapers! More sounds and sound customization options! Make it easier to make custom ringtones! All options should be on the table.

People like fun, and customizing their devices is fun. People will update their iPhones to get more ways to have fun. Apple wants people to update their iPhones. It's a beautiful thing. Let's make it happen. ■


9:41
Wallpaper
Choose
Dynamic
Stills
Live
All Photos
224
Recents
224
Favorites
29
Selfies
3
Live Photos
13

Apple needs to consider how it could add more fun to iOS such as dynamic wallpapers.

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Thanks to a new scan, lung cancer can be detected early when it's more curable. If you smoked, get scanned.

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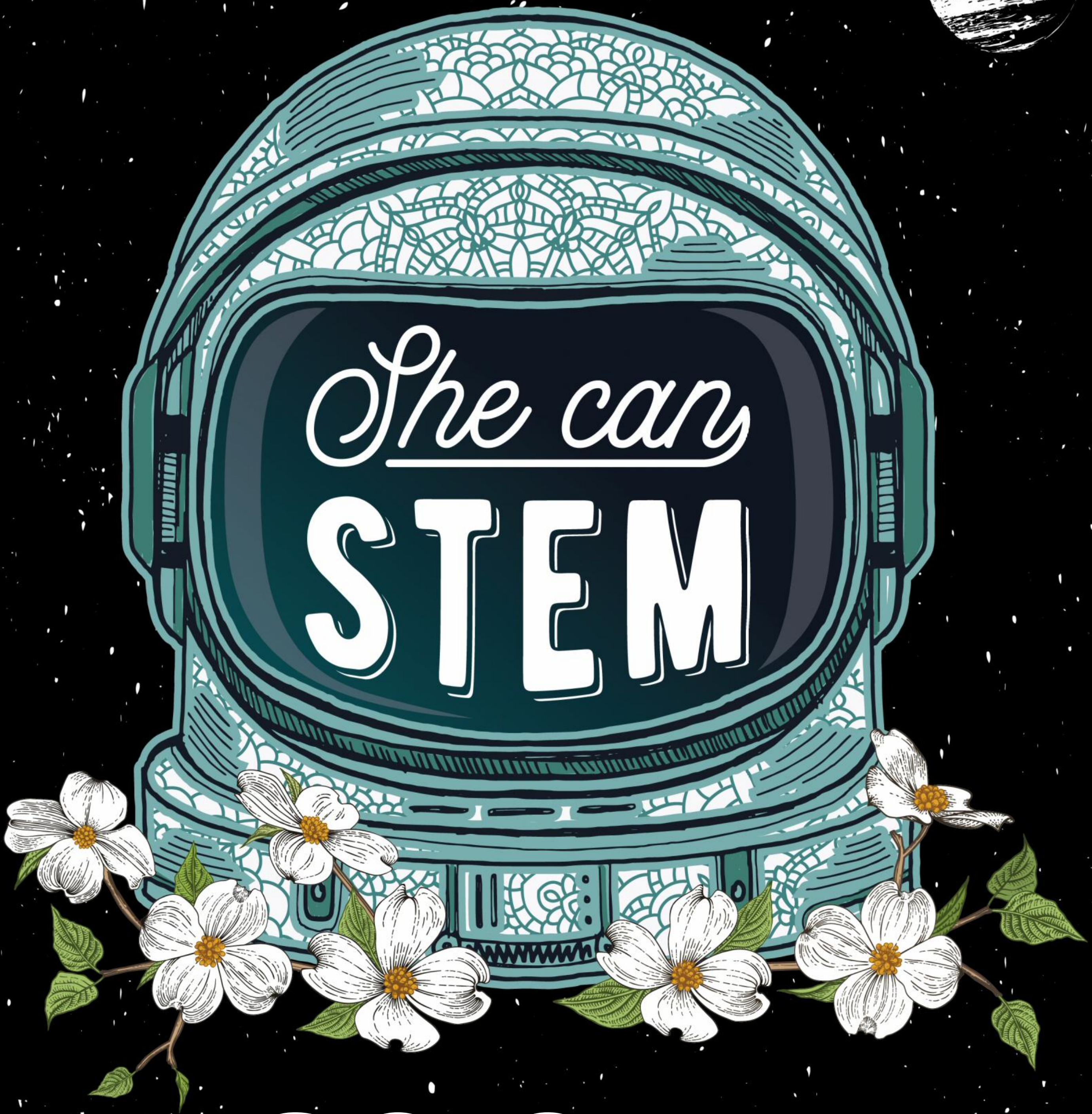
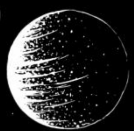
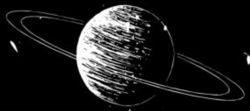

She can
STEM



SO CAN YOU.



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The Latest iOS Products
Reviewed & Rated

REVIEWS

12:18
FaceTime
WED
11
Calendar
Photos
Camera
Mail
Clock
Maps
Weather
Reminders
Notes
Stocks
News
Books
App Store
Podcasts
tv
TV
Health
Home
Wallet
Settings

IMAGE: JASON CROSS

MOBILE PHONE

iPHONE 12 PRO MAX: MAXIMUM DISPLAY, MAXIMUM BATTERY, MAXIMUM CAMERA

BY JASON CROSS

Macworld EDITORS' CHOICE

The iPhone 12 Pro Max is big. Just slightly taller and wider than the iPhone 11 Pro Max (go.macworld.com/11mx) (which was already more than a handful), it is most certainly not for those who insist on one-handed operation.

If you're a big phone kind of person, you'll probably find the Max version of the iPhone 12 Pro to be worth its $1,099 starting price. While its new camera is only a *tiny* bit better, the expansive display and

The iPhone 12 Pro Max is quite a bit larger than the iPhone 12 Pro.

incredible battery life make it worth every penny of its price premium.

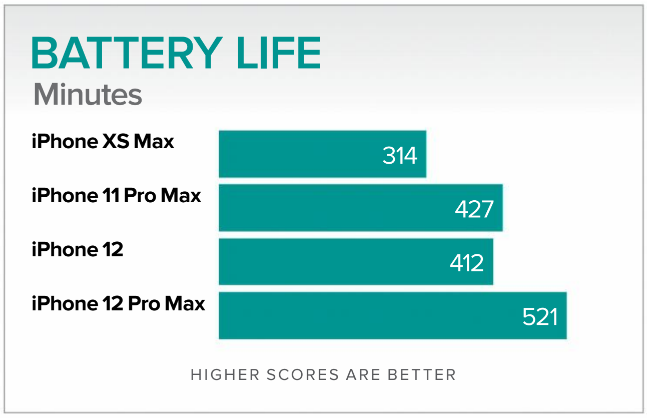
iPHONE 12 PRO, ONLY BIGGER

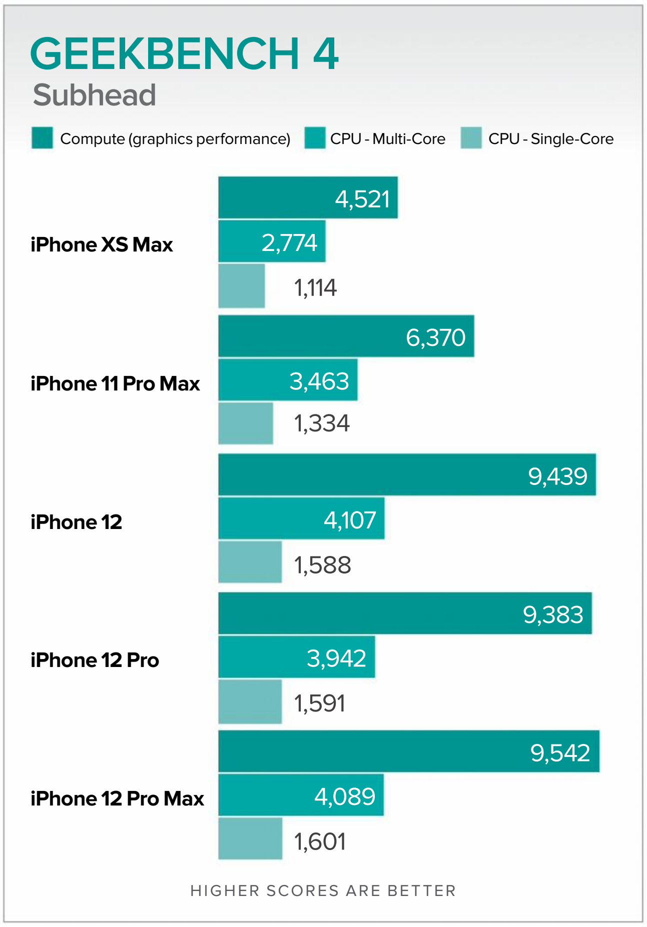
The iPhone 12 Pro Max is essentially just a larger iPhone 12 Pro (go.macworld.com/pr12). It's exactly the same phone in the same colors with the same thickness and style, same display, same A14 chip (go.macworld.com/same), same LiDAR, same MagSafe support… just stretched out to a beautiful 6.7-inch display.

It's a *lot* of phone. If you like really big phones, you'll feel right at home, but if you insist on one-handed operation you will be overwhelmed by this almost tablet-like slab.

Along with the larger size comes a larger battery, and it makes a really big difference. To measure battery life we calibrate the display to 200 nits and run the battery from full to empty using the Geekbench 4 battery test. In this test, the iPhone 12 Pro Max lasted 26 percent longer than the 12 Pro—over 8.5 *hours*! It's by far the longest battery life we've ever measured in an iPhone.

Other performance metrics track right along with the iPhone 12 and iPhone 12 Pro. There are some infinitesimal benefits to the larger size of the Max reducing





thermal throttling of the A14 chip, but you'd never notice it.

A (VERY SLIGHTLY) BETTER CAMERA

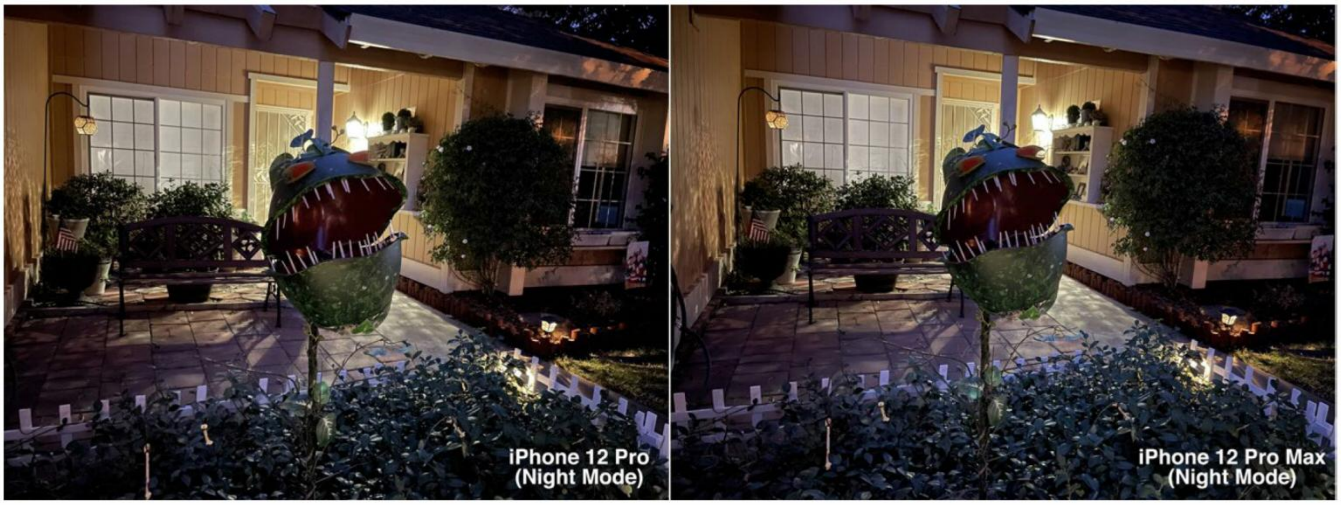
There is one small hardware change between the iPhone 12 Pro and the 12 Pro Max, beyond the obvious size and battery capacity. In a change from last year's iPhone model lineup, the Max version this year has slightly different camera hardware.

The standard wide-angle lens is still 12 megapixels but the sensor is 47 percent larger. This larger sensor is stabilized with a more sophisticated sensor-shift image stabilization system rather than the lens-based stabilization of the other cameras. The result is supposed to be more detail and less noise in low-light environments.

In addition, the telephoto lens is just a little bit *more* telephoto. The iPhone 12 Pro has a 2x telephoto (equivalent to a 52mm focal length), while the Max variant is 2.5x (about 65mm).

There's been a lot of talk about the difference the new wide sensor will make for low-light photography, but try as I might, I could just not produce convincingly better shots than the iPhone 12 Pro. Apple's multi-exposure computational photography is so good that I have a very hard time distinguishing shots between

The camera module may look the same as that on the iPhone 12 Pro, but two of these cameras are a little different.


iPhone 12 Pro
(Night Mode)
iPhone 12 Pro Max
(Night Mode)

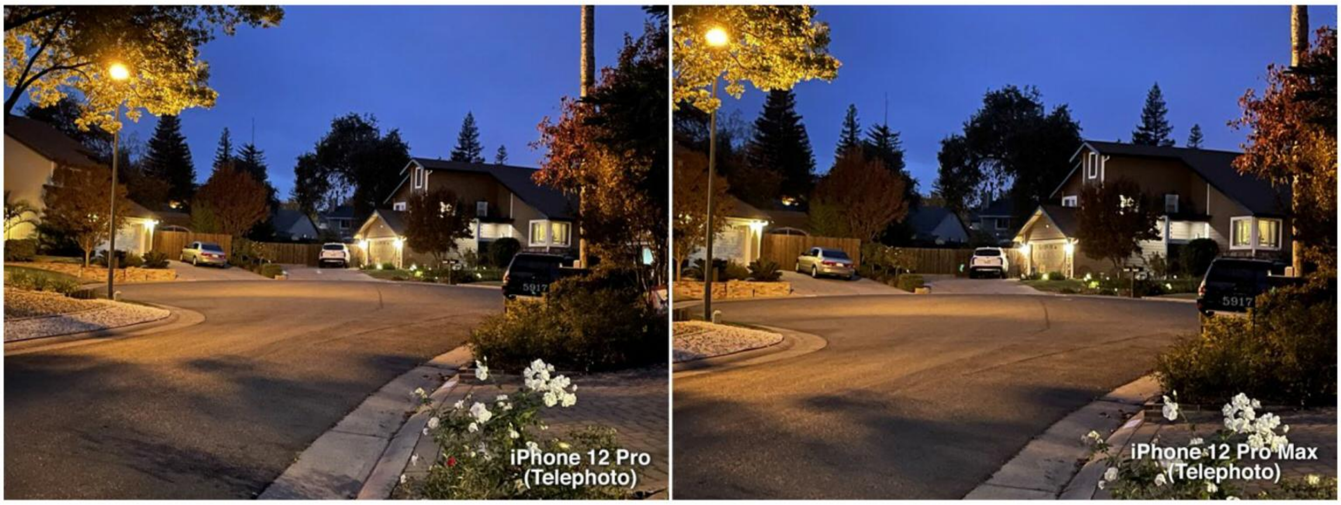
I took a lot of low-light and Night Mode shots trying to get the iPhone 12 Pro Max to look a lot better. It just never really happened.

the old sensor and the new one.

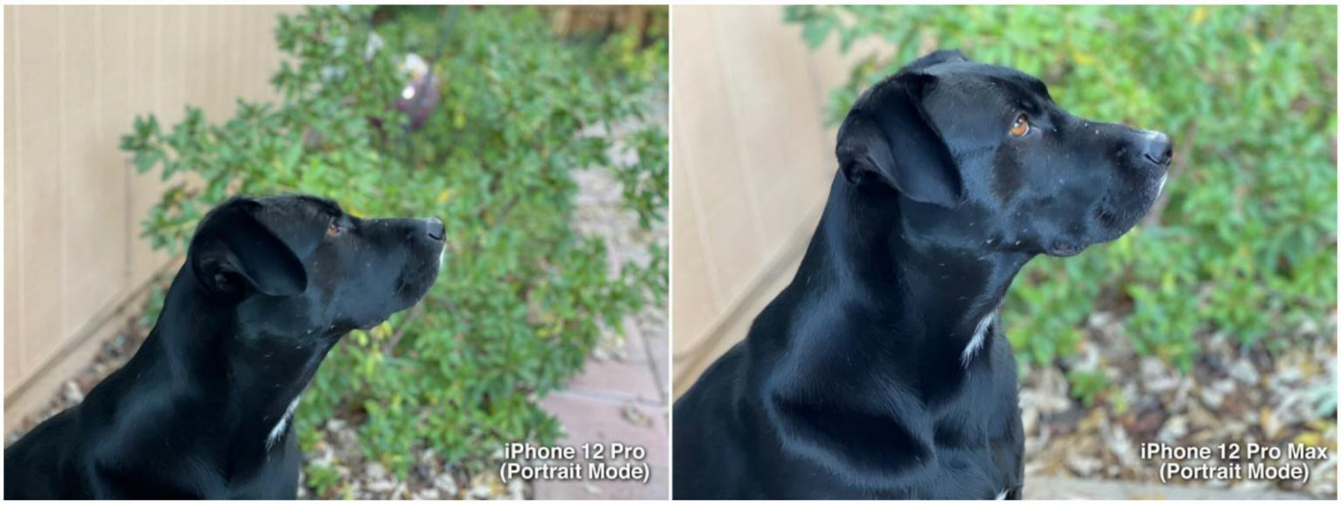
You can find some edge cases where it matters, but even then you'll have to zoom in and pixel-peep to spot the slight improvement in detail or texture from the Max's improved sensor. What I did notice is that the Max regularly takes Night Mode shots with shorter exposure times, and shots in low light without Night mode that have somewhat faster shutter speeds or higher ISO settings.

That means it's easier to hold steady, and you're more likely to get a good shot with a subject that's moving. Even so, it's not a night-and-day difference.

You'll immediately notice that the telephoto lens is a bit longer, though. When shooting Portrait Mode shots you


iPhone 12 Pro
(Telephoto)
iPhone 12 Pro Max
(Telephoto)

The longer telephoto is useful, but produces slightly grainier shots in low light.



The longer telephoto definitely changes the character of Portrait Mode shots. Charlotte has never looked more glamorous.

have a choice between 2.5x and 1x, instead of 2x and 1x on the non-Pro model, and that closer crop creates a totally different feel. But in being longer, the telephoto lens has a narrower aperture, which means a bit more grain and noise when you use it in low light.

If you were considering the iPhone 12 Pro Max over Pro just for its superior camera, I wouldn't bother. There *is* a difference, but it's minuscule; Apple has done such an amazing job with iPhone 12 Pro photography that it's not worth lugging around a huge phone (if you don't want to) just to get a *slightly* better shot in some very particular situations.

BOTTOM LINE

The iPhone 12 Pro Max costs $100 more than the iPhone 12 Pro. If you like really big phones, it's totally worth it. The expansive 6.7-inch display makes videos pop, games more immersive, and web pages easier to read. Most of all, the absolutely epic battery life alone is worth a 10 percent increase in price. That battery life alone could convince some users to carry around a bigger iPhone.

●●●●½

iPhone 12 Pro Max

PROS
- Best battery life ever in an iPhone.
- A slightly better camera than the iPhone 12 Pro.
- Blazing fast performance.

CONS
- Camera improvements are minimal.

PRICE
$1,099

COMPANY
Apple

But the improved camera is not a reason to buy this model. Simply put, the improvements over the iPhone 12 Pro are so seldom seen, and usually so minute, that it shouldn't be a factor in deciding what to purchase. Think of the improved camera as a nice little bonus on top of a phone with crazy performance and battery life. ■

MAC DESKTOP UTILITY

AIR DISPLAY 3: TURN SPARE iOS DEVICES INTO EXTRA MAC DISPLAYS

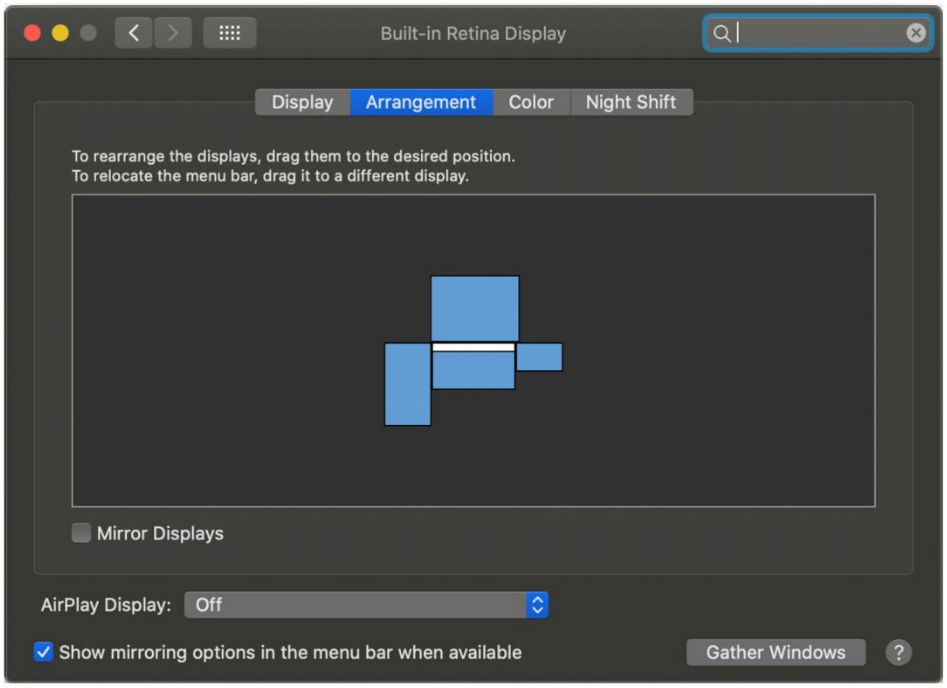
BY J.R. BOOKWALTER

Introduced with macOS Catalina, Sidecar (go.macworld.com/mcsd) is an awesome feature which enables Mac users to extend their desktop onto a single iPad over a wired or wireless connection. There's just one catch: You'll need a Mac released sometime in the last five years to make it work.

Although Apple offers little recourse to owners of older Mac models, as usual the company's cold shoulder has been turned into a new opportunity by third-party developers. Not surprisingly, simply installing the right software will allow similar display trickery on even more

IMAGE: AVATRON

screens, without all those stringent system requirements.



To rearrange the displays, drag them to the desired position.
To relocate the menu bar, drag it to a different display.

☐ Mirror Displays

AirPlay Display: Off

☑ Show mirroring options in the menu bar when available

Air Display 3 adds up to four external displays using the iOS devices or other Macs you already own.

MORE DISPLAYS

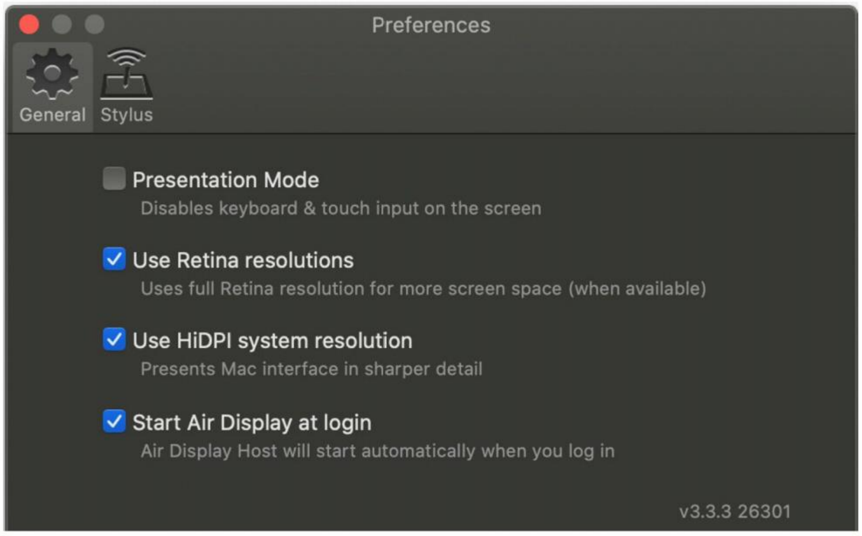
Air Display 3 (go.macworld.com/ard3) turns any iPhone or iPad running iOS 11 or later into an external Mac display. You install the free Air Display Host software on your Mac, and then launch Air Display 3 on your smartphone or tablet that's connected using a standard Lightning cable. Both screens will go black for a moment as the resolution is adjusted, but when they reappear you'll be ready to enjoy a more expansive dual-display experience.

While a USB connection is recommended for best results, Air Display also works wirelessly, provided your computer and mobile devices are on the same local Wi-Fi network. Connecting wirelessly is done via a menu bar app on the host Mac, which doubles as a shortcut for rearranging display settings or toggling preferences between normal, HiDPI, and Retina Display resolutions. There's also an option to connect automatically whenever your device becomes available.

There's no need to stop at just a single external display. Up to four devices can be connected to the same host. Testing confirmed this works better than you might expect, although my late 2015 iMac Retina 5K became a little less responsive with each display added. Newer systems fared better, especially when larger devices like iPad Pro are connected via USB.

CATALINA CAVEATS

While installing Air Display 3 was simple enough, my first attempt at using the external display wasn't quite as smooth. Although I could move the cursor onto the iPad screen, nothing else seemed to work. Turns out macOS Catalina's stricter privacy


Preferences
General
Stylus

☐ Presentation Mode
Disables keyboard & touch input on the screen

☑ Use Retina resolutions
Uses full Retina resolution for more screen space (when available)

☑ Use HiDPI system resolution
Presents Mac interface in sharper detail

☑ Start Air Display at login
Air Display Host will start automatically when you log in

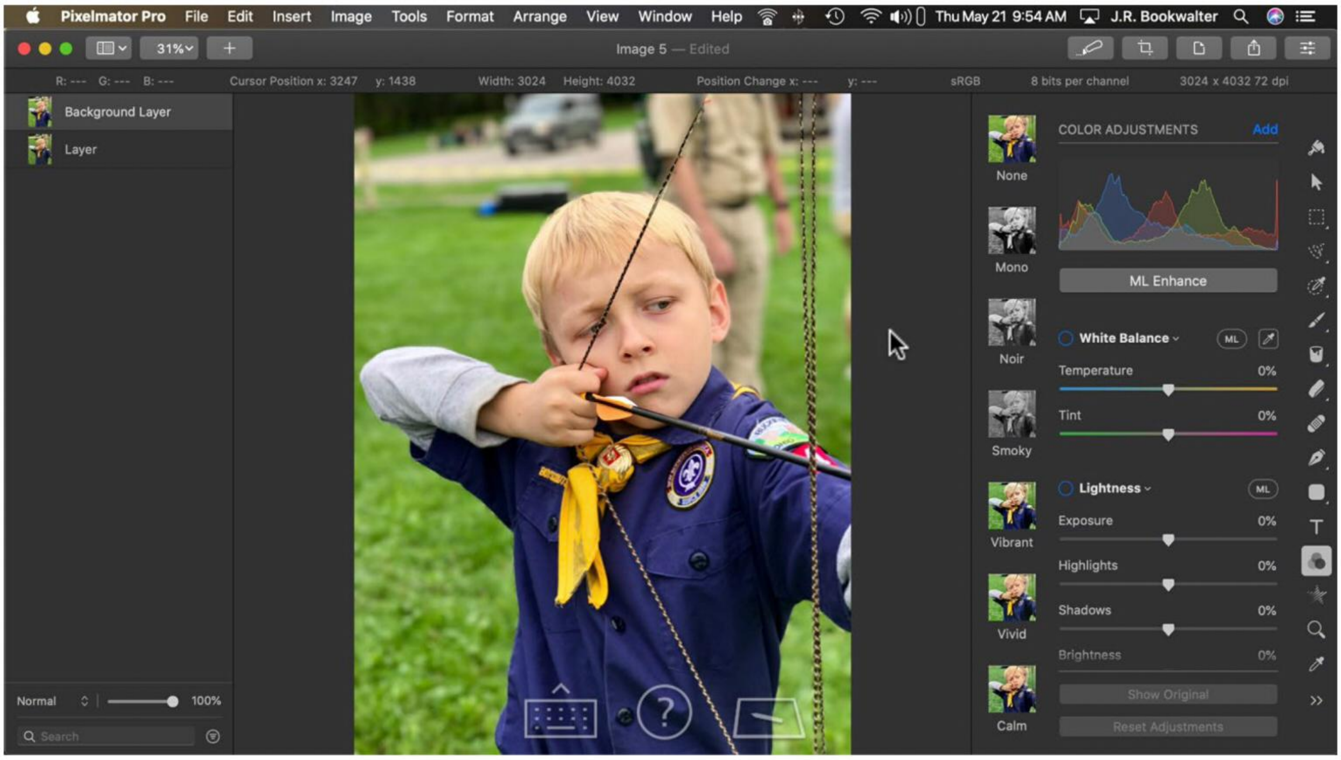
v3.3.3 26301

Air Display Host includes preferences for enabling or disabling conference mode, HiDPI, and Retina Display options.

settings require enabling Air Display Host under System Preferences → Security & Privacy → Privacy → Screen Recording.

Naturally, Air Display doesn't actually "record" your screen in the traditional sense—it's simply an extra security hurdle Apple has imposed on developers and end users alike. (Those running earlier versions of macOS including Mojave can skip this step entirely.)

Speaking of older Macs, should you still own a system running Mac OS X 10.8 or 10.9, developer Avatron maintains a separate legacy version of the host software (go.macworld.com/h0st) for


Pixelmator Pro
File
Edit
Insert
Image
Tools
Format
Arrange
View
Window
Help
Thu May 21 9:54 AM
J.R. Bookwalter
31%
Image 5 — Edited
Background Layer
Layer
COLOR ADJUSTMENTS
Add
None
Mono
Noir
Smoky
Vibrant
Vivid
Calm
ML Enhance
White Balance
Temperature 0%
Tint 0%
Lightness
Exposure 0%
Highlights 0%
Shadows 0%
Brightness 0%
Show Original
Reset Adjustments
Normal
100%
Search

With Air Display 3 running on iPhone or iPad, you can work in Mac apps like Pixelmator Pro on an extended display.

those on Mountain Lion or Mavericks. This is a refreshing policy in an era where old hardware tends to be made obsolete far earlier than it used to be. (Worth noting: Apple broke its virtual video drivers in macOS High Sierra 10.13.4 through 10.13.6, so Air Display 3 also won't work on those versions.)

Although primarily designed to extend or mirror the desktop, Air Display can also be used with an Apple Pencil or other stylus for drawing or painting in your favorite Mac apps which support pressure-sensitive input. I was pleasantly surprised to see how well this worked on the iPad Pro, especially when used in tandem with traditional pinch and zoom gestures to magnify the area of the screen you're working in.

MAC TO MAC

Air Display 3 also offers a way to extend or mirror a desktop to the display of any spare Mac you have lying around, rather than an iOS device. Available separately from the Mac App Store for $20 (go.macworld.com/adms), the client app is launched from the computer to be used as an extra display and works with the same Air Display Host software already installed for the iOS version.

When in use, the host Mac desktop appears as a new window on the client Mac, which can be resized as needed or made full screen. In testing, I was able to turn a lowly 13-inch early 2015 MacBook Air into the equivalent of a 24-inch external display with a resolution of 1440x900.

One neat thing about Air Display for Mac is how the host can be controlled from either computer's keyboard and mouse (but not vice versa). The Mac version can also be used with up to four clients, which can be a mix of computers and iOS devices. I did have occasional issues reliably accessing the Dock when configured to be automatically hidden, but our overall experience was generally positive.

BOTTOM LINE

Whether you're a MacBook owner with an occasionally need to expand the desktop while on the road or a Mac Pro user who can never have enough screens, Air Display 3 is a cost-effective way to add up to four displays using devices you already own. ■

Air Display for iOS 3.3.6

PROS

- Wirelessly extend or mirror Mac desktop on up to four iOS, macOS devices.
- Pressure-sensitive input support for Mac applications.

CONS

- Occasionally sluggish performance with multiple displays on older Macs.
- macOS Catalina requires one-time modification to System Preferences.

PRICE

$15

COMPANY

Avatron

Air Display for macOS 3.3.3

PROS

- Host Mac can also be controlled from client computer.

CONS

- Difficultly accessing Dock when hidden.
- iOS, macOS clients must be purchased separately.

PRICE

$20

COMPANY

Avatron

MacBook Air

AN ABSOLUTELY STUNNING DEBUT FOR APPLE SILICON IN A MAC

MACBOOK AIR M1 REVIEW

IT MAY BE NOTHING MORE THAN A PROCESSOR CHANGE, BUT WHAT A PROCESSOR!

BY JASON CROSS

IMAGE: APPLE

When Apple said it would start producing Macs with its own system-on-chip processors, custom CPU and GPU silicon (and a bunch of other stuff) to replace parts from Intel and AMD, we figured it would be good. I never expected it would be this good.

Looking at the incredible performance of Apple's A-series SoCs for iPhones and iPads, one could extrapolate to a laptop chip that offers really good efficiency and performance. To say that Apple delivered would be the understatement of the year.

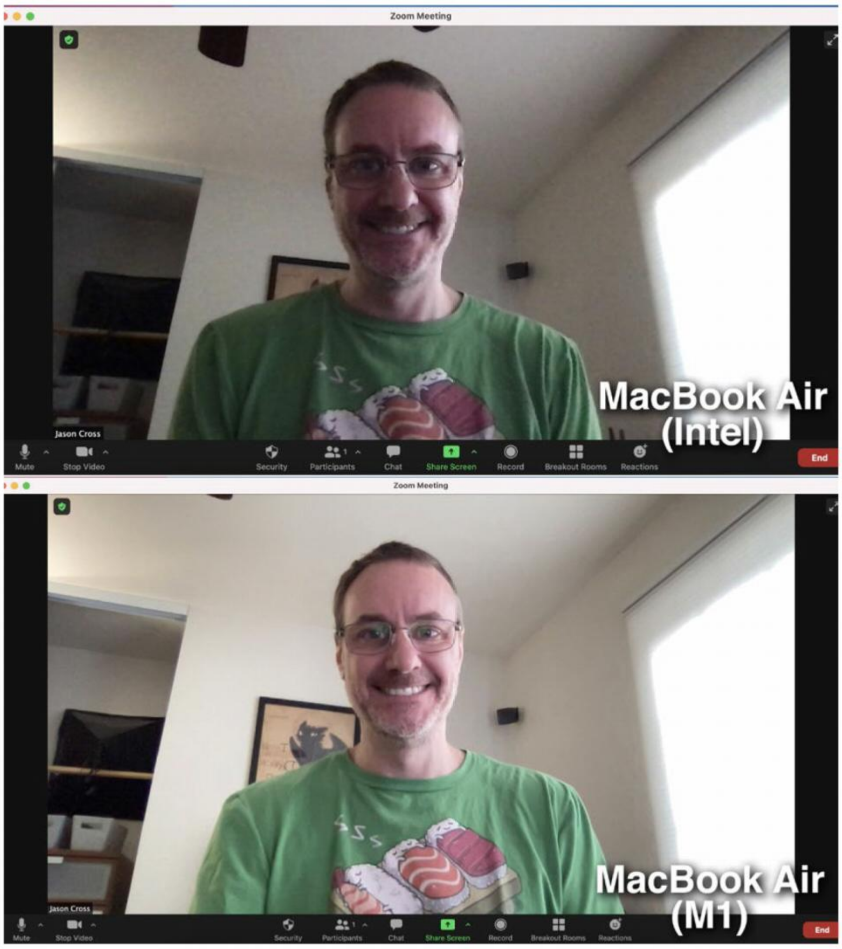
The MacBook Air with the new M1

PODCAST: **APPLE'S M1 MACS: THE NEW MAC REVOLUTION**
Listen now at go.macworld.com/m1p

processor so absolutely and thoroughly trounces the Intel version released earlier this year (with Intel's "Ice Lake" Y-series CPU/GPU) that it defies belief. Unfortunately, Apple changed practically nothing else about the MacBook Air. This new model is exclusively a processor swap. But what a processor!

IT'S WHAT'S ON THE INSIDE THE COUNTS

From the outside, you can't tell the Intel-based MacBook Air from the one with Apple's new M1 chip. It's in the same enclosure, weighs the same, has the exact same excellent Magic Keyboard and still the best trackpad in the business.


Zoom Meeting
Jason Cross
Mute
Stop Video
Security
Participants
Chat
Share Screen
Record
Breakout Rooms
Reactions
End
MacBook Air (Intel)
Zoom Meeting
Jason Cross
Mute
Stop Video
Security
Participants
Chat
Share Screen
Record
Breakout Rooms
Reactions
End
MacBook Air (M1)

With the M1 chip, Apple can really clean up the output of the crummy old 720p webcam. But it's still not very good.

The 2560x1600 display supports P3 wide color and True Tone and gets as bright as 400 nits, just as the one on MacBook Air released earlier this year. It has the same 44.9 watt-hour battery (though it lasts a lot longer).

The webcam is even still the same age-old 720p webcam that has plagued Apple's laptops for years. The superior image processing afforded by the M1 chip really does a fantastic job of improving exposure, contrast, and noise in poor light, but it's still blindingly obvious that Apple should have upgraded its webcams several years ago.

There are two small differences worth noting. First, the function key row at the top of the keyboard has changed F4, F5, and F6 from Launchpad, key brightness down, and key brightness up, to Spotlight search, Siri dictation, and Do Not Disturb. It's a good change, as these are far more useful functions.

Second, the Thunderbolt 3 ports no

You'd be hard-pressed to tell the difference between the new MacBook Air and the old one.

longer support external GPUs, and only support a single external display in conjunction with the built-in display (at up to 6K at 60Hz with HDR). The old Intel-based models supported multiple simultaneous external displays and external GPUs.

APPLE'S STUNNING M1 CHIP

The MacBook Air is a laptop whose design and features can most charitably be described as "classic," so it's a little disappointing at first to discover that Apple did nothing but replace Intel's chips with its own M1. That is, until you discover just want an amazing processor the M1 is.

Apple's reveal of this new MacBook was full of hyperbole, with outrageous claims about being several times faster than the previous MacBook Air and faster than most PC laptops (even bigger, more expensive ones). All in a MacBook Air chassis that doesn't even have a fan and squeezes out at least 50 percent more run-time out of the same battery.

Apple's claims may be a little cherry-picked, but the hype is real. Nobody is more stunned than myself.

Granted, Apple has recently hobbled the MacBook Air with Intel's underperforming Y-series processors, rather than the more capable U-series chips of days past. But in test after test, this new Air just absolutely smokes the one Apple released just earlier this year. It blows away 13-inch MacBook Pros. It's often just about 30 percent slower than a high-end 16-inch MacBook Pro with a Core i9 and Radeon 5500M discrete graphics.

And bear in mind, we're testing the absolute entry level model here, which has an 8-core CPU, 7-core GPU, 8GB of RAM, and a 256GB SSD. The old MacBook Air to which we'll compare it is not the base model, but the $1,299 upgraded model with a quad-core Core i5-1030NG7 processor and 11th-generation Iris Plus G7 graphics.

Let's start with our standby, Geekbench 5, where we see the single-core performance of this thin-and-light fanless laptop blowing away even a 16-inch Core i9 based MacBook Pro. Multi-core performance is 2.3 times faster than the

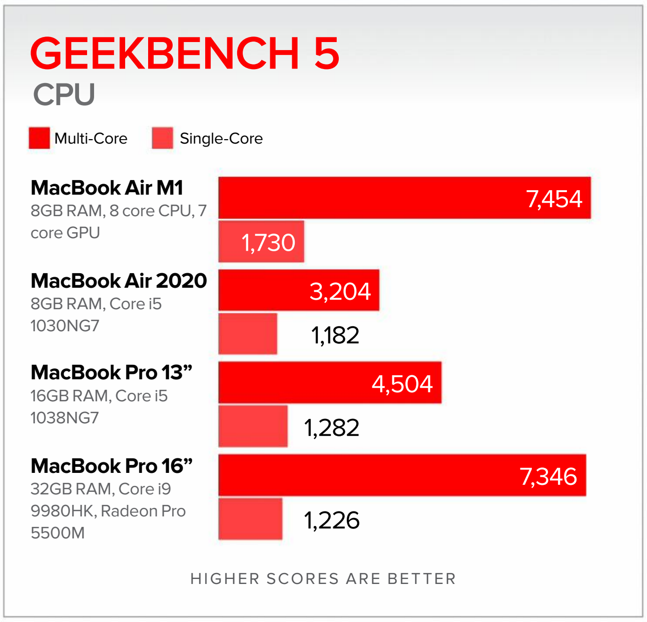
Intel-based Air, and on par with the Core-i9 MacBook Pro.

Cinebench does CPU-based ray traced rendering using Maxon's Cinema 4D engine. The new R23 release supports Apple silicon, and we can see the new MacBook Air crush the old one by 65 percent in single-core performance and 265 percent in the multi-core test. Even our Core i9-based 16-inch MacBook Pro is about 30 percent slower in single-core perf and only 30 percent faster in multi-core.

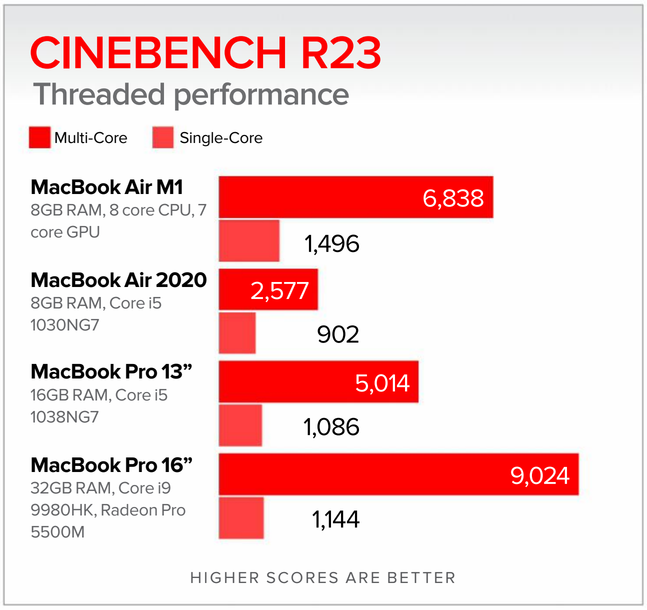
MacBook Air (Intel)
MacBook Air (M1)

Apple tweaked the function key shorcuts just a little, but that's the only external difference betwen the M1 and Intel MacBook Air.

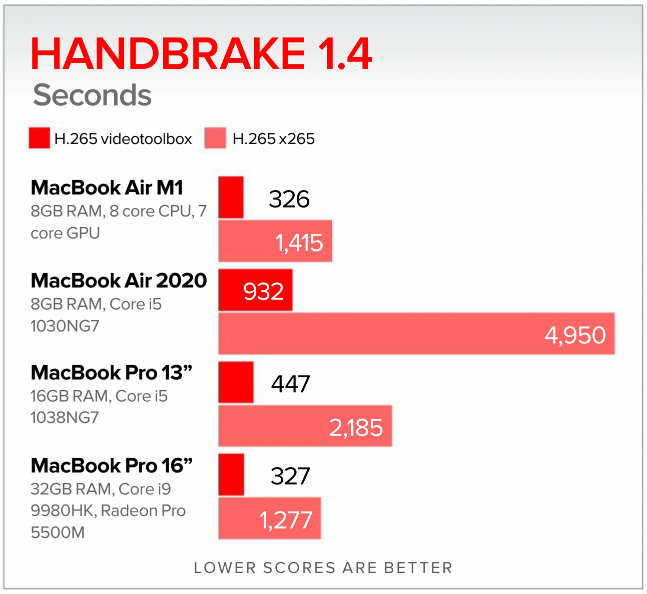
Handbrake is another favorite



Your eyes do not deceive you. This fanless laptop really is that fast.



Stunning single-core performance and multi-core performance not far behind a Core i9!



Video encoding is crazy quick.

benchmark for CPU enthusiasts. We used the latest 1.4 beta that is optimized for Apple silicon, and encoded the 4K Tears of Steel (go.macworld.com/4ktr) video to a 1080p H.265 file. Encoding entirely in software with the CPU cores, the M1-based Air finished a whopping 3.5 times faster than the old Air, and only about 11 percent behind the Core i9 16-inch MacBook Pro!

If we allow the app to use the VideoToolBox framework for video encoding acceleration, it can use the video encoding hardware in the M1 chip, and Intel’s Quick Sync or AMD’s VCE engine in the other MacBooks. With that enabled, the encoding time drops a lot on all our test subjects, but the new Air is still 2.8 times faster than the old one, and just as fast as our nearly-$4,000 16-inch MacBook Pro.

This gaping performance gulf isn’t limited to benchmark apps. I made a simple iMovie using one of the built-in themes with a handful of photos and video clips, then exported it to 1080p at ProRes quality. The new MacBook Air finished in 16 seconds, the Intel-based model took 36.

Oh, and lest I forget, Apple beefed up the SSD performance, too. I measured nearly 2.8 GB/sec of read performance and 2.5 GB/sec of write performance, *double* that of the old Air and roughly on par with our high-end 16-inch MacBook Pro.

Performance is about more than benchmark charts, and you can feel the speed of this new MacBook Air every time you use it. It wakes up and is ready for use immediately. Apps snap open more quickly and are more responsive. Photo and video editing feels more fluid, and big tasks like video exports take a fraction of the time.

SHOCKING GRAPHICS PERFORMANCE

Apple’s integrated graphics technology is just as impressive as its CPU. We’re used to seeing how fast it is in an iPhone or iPad, but the demands of windowed operating systems like macOS and the apps they run are often much higher.

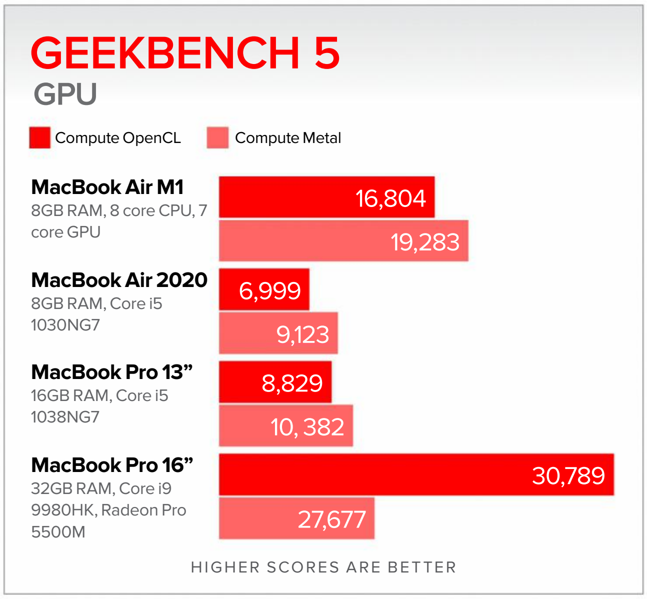
Bear in mind that our MacBook Air has only 7 active GPU cores—an upgraded version is available with all 8 cores active, and all 8 are active in the new 13-inch MacBook Pro and Mac mini. Our configuration also has only 8GB of RAM shared between CPU and GPU, which we figured would surely just tank some of these tests.

Geekbench 5 can run a series of tests using the GPU to do general computational tasks (rather than traditional 3D graphics rendering) using either OpenCL or Metal APIs. Metal is the one you usually care about for a Mac, but OpenCL can be useful to compare against other platforms.

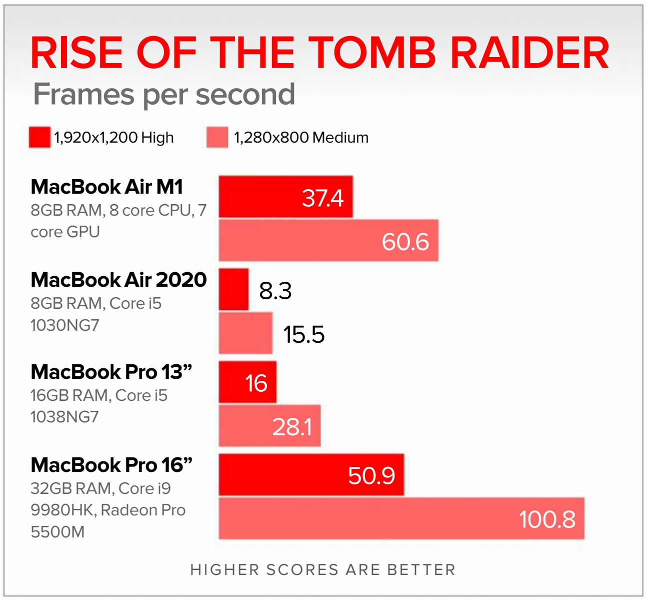
In those tests, the new MacBook Air is more than twice as fast as the old one with Intel's GPU. It's even about 90 percent faster than a modern Core i5-based 13-inch MacBook Pro, though it can't hold a candle to the dedicated Radeon 5500M GPU in the 16-inch MacBook Pro.

Just for kicks, I ran benchmarks of a couple of modern games: *Rise of the Tomb Raider* and *Civilization VI*. Note that these games are not optimized for Apple silicon; they're Intel-optimized versions downloaded from Steam (also Intel-optimized), running under Rosetta2 emulation (go.macworld.com/r2em). Surely the limited 8GB of RAM and extremely conservative power profile of this laptop would make these games unplayable, right?

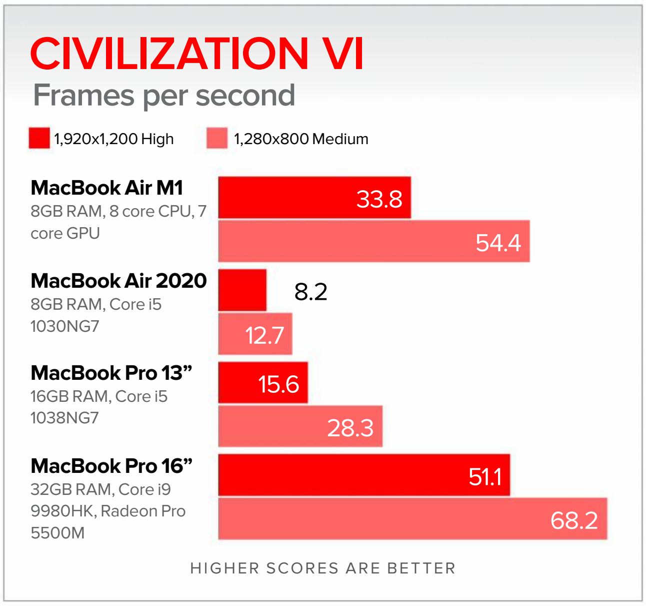
MacBook Airs have never been gaming machines, but I'm absolutely gobsmacked by these results. I had to run them all three times to be sure. The Ice Lake Y-series CPU and GPU gets predictably poor results running these games; it's a familiar story. But just look at the M1 go! It's delivering four times the frame rate in these games taking them from



Double the GPU compute power of Apple's Intel-based 13-inch laptops.



Remember, this is a fanless three-pound laptop running the game under Rosetta2 emulation!



Those other 13-inch MacBooks were never good gaming machines, but this performance leap is ridiculous!

“unplayable” to “playable.”

I got double the frame rate of the 13-inch MacBook Pro with a Core i5. Hell, the 16-inch MacBook Pro, with its Core i9, 32GB of RAM, and dedicated Radeon 5500M GPU is only 30 to 50 percent faster.

Again, those results are with games not optimized for the ARM-based architecture of the M1 at all, but rather with the Rosetta2 emulation layer. In a three-pound, fanless laptop. Simply shocking!

COMPATIBILITY, CHECK

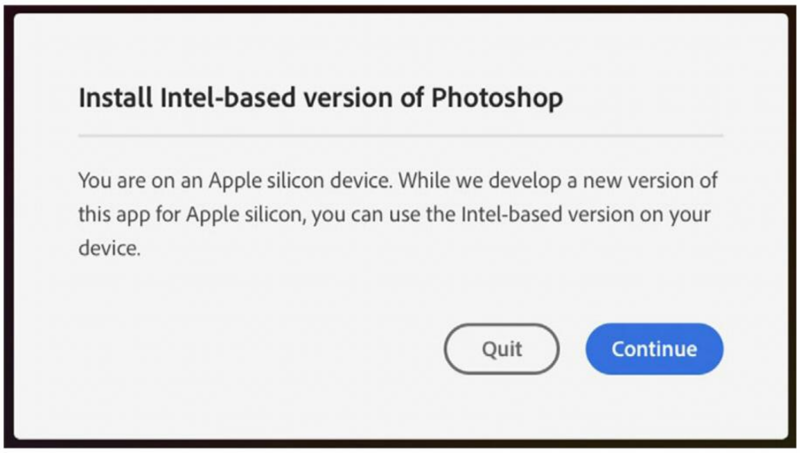
Which brings us to compatibility. Apple’s M1 processor uses an entirely different architecture and instruction set (ARM_64) as the Intel processors we’ve seen in Macs since 2006 (x64). To make sure all your existing apps still run, Apple relies on a technology called Rosetta2 that translates between the two instruction sets, at a pretty steep performance cost. (The first Rosetta was a similar technology for the PowerPC-to-Intel transition.)

All of Apple’s apps have been updated to Universal apps, supporting both Intel and Apple silicon. That means everything that comes with macOS Big Sur—Safari, Maps, Messages, Photos, TV, Voice Memos, News, you name it. Even Apple’s professional apps like Final Cut and Logic have been updated.

Other apps are hit-and-miss. None of Adobe’s Creative Cloud suite is updated yet, so Photoshop, Lightroom, and Premiere all run under Rosetta2 emulation (Adobe warns you of such as you download it). Curiously, the actual Creative Cloud app itself, the thing that downloads and updates all the other apps, is a beta optimized for Apple silicon. Adobe says a Universal version of Lightroom is coming soon, and Photoshop early next year.

My favorite writing app, iA Writer (go.macworld.com/iwri), has been updated to Universal. So are excellent apps like Pixelmater Pro (go.macworld.com/pxp2), DaVinci Resolve (go.macworld.com/dvrs), or Fantastical (go.macworld.com/fnttl).

But Microsoft’s Office suite of apps, Zoom, Firefox, Chrome, Steam, and dozens of other everyday apps have not



Install Intel-based version of Photoshop

You are on an Apple silicon device. While we develop a new version of this app for Apple silicon, you can use the Intel-based version on your device.

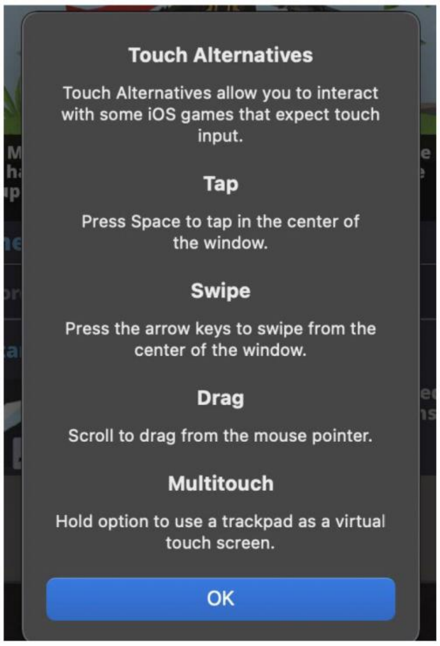
Quit
Continue

Adobe warns that you're downloading unoptimized apps, but they work fine and run as well as on the latest Intel-based MacBook Air.

yet been updated to Universal apps.

The good news is, every single app I tried ran absolutely fine with Rosetta2 emulation. You just download the app, run it, and and it's like nothing has changed. There can be a small delay when you first run some apps, but it's smooth sailing after that. Yes, there's a huge performance hit, but even Intel-optimized apps running under Rosetta2 tend to feel as smooth and responsive with this new MacBook Air as they do on the Core i5 based model. The singular exception to this, after testing *dozens* of apps, is Steam (go.macworld.com/stem), whose interface stutters badly. Steam *games*, as previously discussed, actually run much faster under emulation than on comparable Intel-based Macs.

Projects
Cousins Trip
My Media
Audio
Titles
Backgrounds
Transitions
Lake Trip
All Clips
Search
Reset All
00:13 / 00:24
Settings
Voiceover 1
Kids Playing
MacBook Air



Touch Alternatives

Touch Alternatives allow you to interact with some iOS games that expect touch input.

Tap

Press Space to tap in the center of the window.

Swipe

Press the arrow keys to swipe from the center of the window.

Drag

Scroll to drag from the mouse pointer.

Multitouch

Hold option to use a trackpad as a virtual touch screen.

Apple added some simple keyboard controls to make playing iPhone games easier.

iPHONE APPS ON YOUR MAC? BELIEVE IT!

One of the selling points of building Macs with processors derived from the DNA of Apple's iPhone and iPad chips is that it's trivial to make iPhone and iPad apps actually run on a Mac.

To that end, Macs with the M1 chip can download iPhone and iPad apps right from the Mac App Store. If you own them on the iPhone or iPad, you won't need to re-buy them.

There are some caveats. While the apps I've tried run like butter (no surprise given the hardware involved), most iPhone apps run at a fixed window size while many iPad apps are resizable. Developers can opt out of having their apps listed, and many top apps have done so. If you were hoping for Instagram, Netflix, TikTok, Snapchat, Xbox, Playstation, or *anything* from Google, you're going to be disappointed.

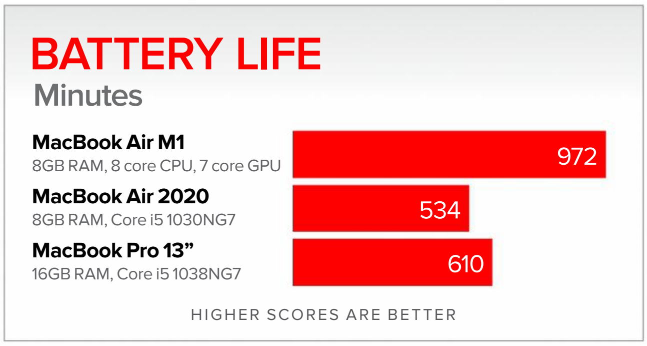
Still, there's a lot here. Facebook is, oddly enough. Amazon Alexa and Prime Now (but not Amazon Shopping) are present, and so are apps for many major airlines. There are tons of iOS games. Apple even built in some touch alternatives for iOS games to make them easier to play: use arrow keys to swipe, spacebar to tap in the center of the screen, or hold Option to use the trackpad like a virtual touchscreen.

This is early days, and some more options would be welcome (like a window scaling feature) but this is an absolute win. As frustrating as it can be when an app is not listed, there's enough here to greatly expand the usefulness of owning a Mac. I can only hope more developers embrace it. C'mon Netflix, what do you have to lose?

ALL THIS AND CRAZY BATTERY LIFE, TOO

With such a frankly astonishing leap in performance, we might expect battery life to take hit. If it was the same as the Intel-based MacBook Air, we'd be happy.

But the battery in the new Air lasts a *lot* longer than it ever has. Apple claims you'll get 15 hours web browsing (up from 11 hours in the old Air), 18 hours video playback (up from 12), and twice the life while video conferencing. I'm sure we don't test exactly as Apple does, but I generally found the



It's crazy to think this MacBook Air lasts this much longer *and* runs several times faster.

battery life to be a whopping 50 percent longer than in the MacBook Air I reviewed earlier this year (go.macworld.com/air2).

We set the display to 150 nits and loop a movie downloaded from the TV app (at max quality) until the battery dies. In this test, the M1-based Air lasted *82 percent longer* than the Intel-based one from earlier this year, and 50 percent longer than the one I reviewed in 2018 (go.macworld.com/air8.

That's not a fluke. That's not an edge case. It's not that video playback sips power while other tasks don't. In everyday mixed use—browsing the web, watching videos, editing photos, writing emails, and all the other things we use MacBook Airs for—the new model easily lasts *hours* longer than the old one.

I guess I shouldn't be surprised. The fact that Intel-based MacBook Airs require a fan and the M1 is fanless should be all the hint we need about the energy efficiency of the processor. Still, to squeeze out easily 50 to 80 percent more battery life out of the same exact battery, *while* delivering *several times* the performance, is astounding.

BOTTOM LINE

We haven't had the new M1-based Macs long enough to really dig into every little facet of the new Apple silicon. But after days of furious benchmarking and non-stop use, I can confidently say this: Apple has accomplished a truly incredible feat. Its chip delivers frankly shocking performance in this power profile.

When looking at my performance test results, I had to remind myself over and over: this is the entry-level $999 model, with a mere 8GB of RAM and the 7-core GPU. If this is the super-low-power bottom of the stack, what will higher-performance "Pro" chips deliver? The mind boggles.

If you're in the market for a MacBook Air, there are no more Intel-based models to consider. And no wonder—even when emulating the Intel chip, this new Air usually outpaces the upgraded quad-core version of the old one. When running updated Universal apps, it's an absolute rout. Did I mention it runs iPhone and iPad apps, too? While I'm suitably impressed with the performance of this 8GB model, I suggest getting 16GB, since it can never be upgraded.

If you're considering a higher-end Mac, you may want to wait to see what Apple has in store for future, higher-performance chips. It's certainly hard to recommend opening your wallet for an Intel-based Mac after seeing what Apple can do in a little fanless MacBook Air.

It's not all good news, though. Apple missed a good opportunity to make real improvements to the MacBook Air beyond the processor. The ancient 720p webcam is a laptop crime, even if the M1 chip does a better job of cleaning up its output. Display improvements (HDR, variable refresh rate, or high refresh rate) would all be welcome. Face ID feels like it should have reached the Mac a year or two ago.

If you're in the market for a MacBook Air, you'll be astounded by the performance and battery life on display here, and I think the vast majority of users need not worry about whether or not their favorite apps have been updated to support the M1 yet—Rosetta2 emulation works beautifully. If you're waiting for the next big evolution of the Mac, this feels like only half the picture, the "inside" half, with the "outside" half hopefully on the way sooner rather than later. ■

★★★★½

MacBook Air (M1, 8-core CPU, 7-Core GPU, 256GB storage)

PROS

- Shocking performance.
- Totally silent—no fan.
- Incredible battery life.

CONS

- Ancient 720p webcam.

PRICE

$999

COMPANY

Apple

WHEN YOU'RE **BUZZED**, YOU GET IDEAS. LIKE ASKING EVERYONE INSIDE THE TACO TRUCK WHAT **DRIVING** AROUND IN A KITCHEN **IS** LIKE AND THEN ORDERING 22 TACOS WITH EXTRA GUACAMOLE AND ALL THE CHEESE FOR EVERY **DRUNK** PERSON IN LINE. BAD IDEA FOR YOUR WALLET, BUT NOT AS BAD AS **DRIVING** HOME BUZZED.

NHTSA

ad COUNCIL

13-INCH MACBO
REVIEW

AMAZING BREAKTHRO
AND BATTERY PERFOR

IMAGE: APPLE

OOK PRO M1

OUGHS IN PROCESSING
RMANCE **BY ROMAN LOYOLA**

algoriddim
NEURALMIX
MacBook Pro

Macworld EDITORS' CHOICE

For years, it's been iPhone this, iPhone that. And for good reason. But now, the Mac—the platform that pushed Apple to the forefront of computing—is back in the spotlight. And for good reason.

While the Intel years were good for the Mac, Apple needed something to take its computer to the next level. That something now comes in the form of Apple's own system on a chip (SoC), called the M1. Along with macOS Big Sur (the OS built for the M1), the Mac makes breakthroughs in performance and battery efficiency that were never possible with Intel silicon.

This review takes a look at the $1,299 13-inch MacBook Pro, which has an Apple 8-core M1. This SoC includes 8GB of RAM and an 8-core graphics processor. The laptop also comes with a 256GB SSD, a 13.3-inch LED-backlit display, a 58.2-watt-hour lithium-polymer battery, and a 61W USB-C power adapter.

As the tests will show, this Mac is an astounding machine.

PERFORMANCE BENCHMARKS

Apple made bold claims during its "One more thing event" on November 10. The company said (go.macworld.com/cmsd) its new 13-inch MacBook Pro's M1 CPU is up to 2.8 times faster than the 1.7GHz quad-core Intel Core i7 in a same-sized MacBook Pro. (This Intel Core i7 was available as a built-to-order option for the previous $1,299 13-inch MacBook Pro, a machine that came standard with a 1.4GHz quad-core Core i5 when it was released earlier this year.)

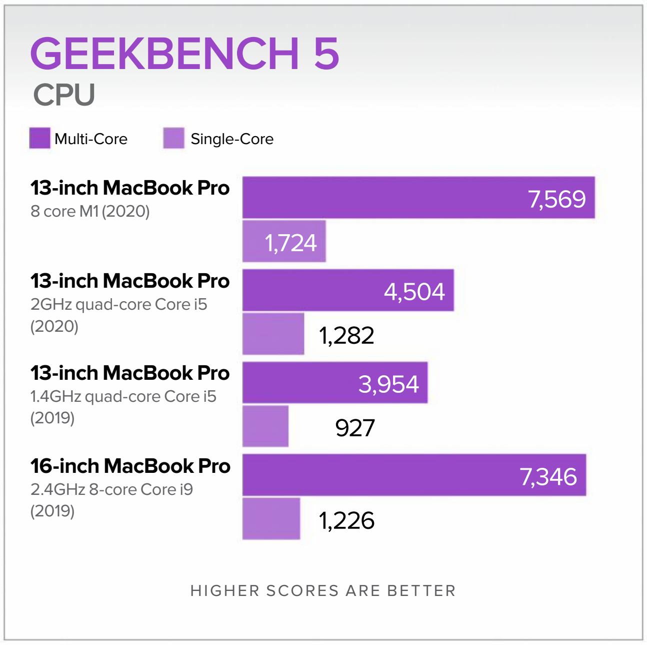
We don't have this specific laptop that Apple uses for its performance comparison. But we do have three other MacBook Pro models that can help us draw some conclusions as we test them against the 13-inch MacBook Pro M1. Specifically:

> The $1,799 13-inch MacBook Pro with a 2.0GHz quad-core Core i5 (it's still available for purchase)

> The 2019 13-inch MacBook Pro with a 1.4GHz quad-core Core i5 (it originally sold for $1,299)

> The beefed-up 16-inch MacBook Pro with a 2.4GHz 8-core Core i9 (with its 32GB of RAM and 2TB SSD, it sells right now for $3,899)

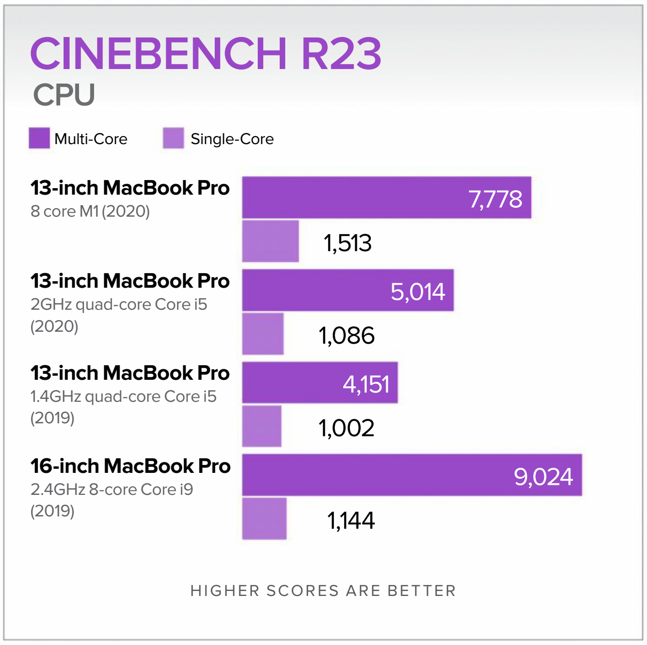
So what did we find out? Well, we might not have been able to replicate Apple's 2.8 times increase in performance, but what we did see was exciting nonetheless. Sometimes the results left us awestruck.

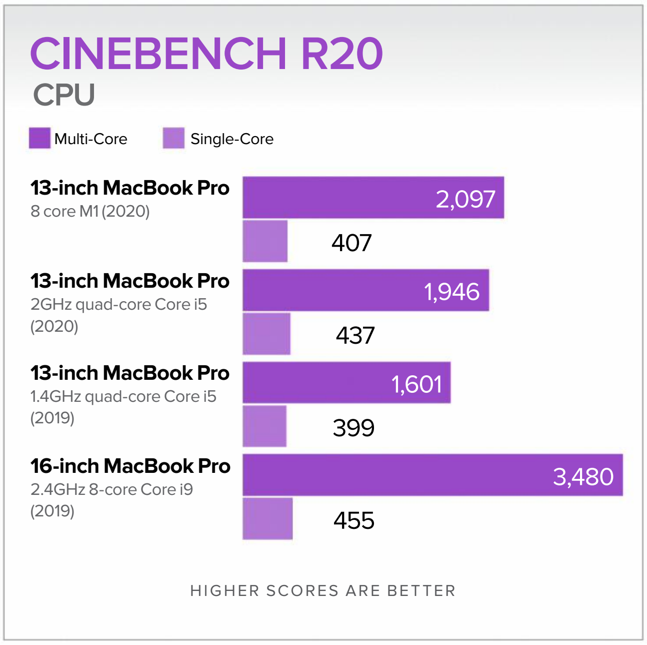


We first turn to Geekbench 5 (go.macworld.com/t2g5), where the new M1 delivered awesome results. In the benchmark's Single Core test, the M1 MacBook Pro left all of the other laptops in the dust, showing an 85 percent improvement over the 1.4GHz MacBook Pro; 34 percent over the 2.0GHz Core i5 MacBook Pro; and 40 percent over the 16-inch model.

It gets even better with Geekbench 5's Multi-Core test, where the 8-core M1 MacBook Pro was faster than the 16-inch MacBook Pro with its 8-core Core i9 chip. And the M1 laptop blew past the other 13-inch models we tested, posting a 68 percent improvement over the 2.0GHz quad core Core i5 MacBook Pro, and a 91 percent improvement over the 1.4GHz quad core Core i5 MacBook Pro.

The impressive results continued in our Cinebench R23 (go.macworld.com/cr23)





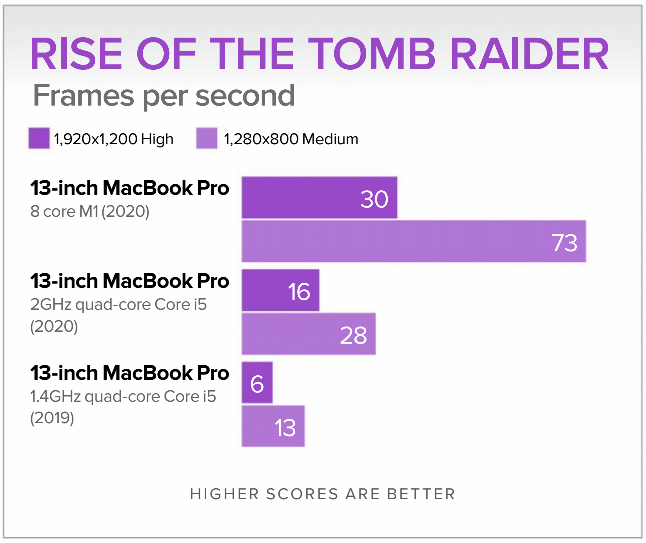
testing. In multi-core testing, the M1 MacBook Pro saw improvements of 54 and 87 percent over the 2.0GHz Core i5 MacBook Pro and 1.4GHz Core i5 MacBook Pro, respectively. In this test, however, the 16-inch 2.4GHz Core i9 actually beat the M1 MacBook Pro (but not by much).

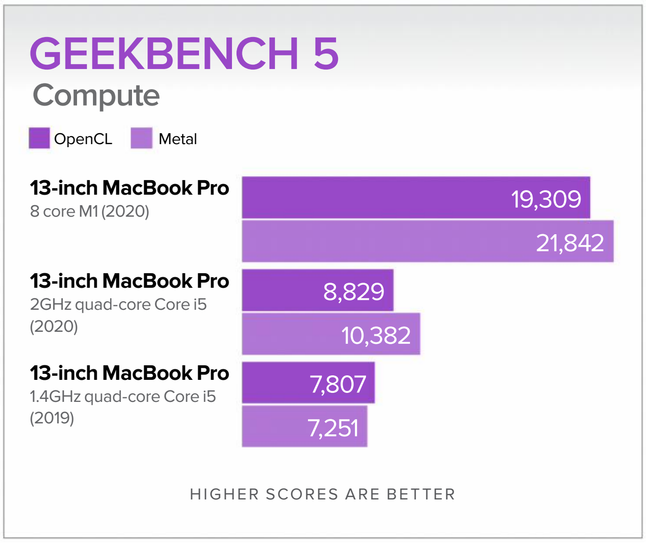
Our Geekbench 5 and Cinebench R23 scores were collected using "Universal" versions on those benchmarks, which means the M1 MacBook Pro was able to run native versions of the tests, taking advantage of all the optimizations built into the Apple silicon chip and macOS Big Sur. So, to see what performance is like when running in emulation mode, we ran Cinebench R20, which only supports Intel processors natively. When this test runs on an Apple-silicon Mac, the machine uses Rosetta2, an on-the-fly translator.

In Cinebench R20, we did see a hit in performance, but the M1 MacBook Pro was still faster than the other two 13-inch models we tested. Compared to the 2.0GHz Core i5 MacBook Pro, the M1 laptop was only 7 percent faster. The M1 MacBook Pro was still faster than the 1.4GHz Core i5 MacBook Pro, but it was beaten by the 16-inch 2.4GHz Core i9 laptop.

GRAPHICS PERFORMANCE

A portion of the M1 SoC is dedicated to an 8-core GPU, which replaces the integrated Intel graphics in previous machines. With the $1,299 and $1,499 Intel-based 13-inch MacBook Pros, the graphics performance was acceptable for most tasks, but you had to lower the graphics settings in demanding games in order to get

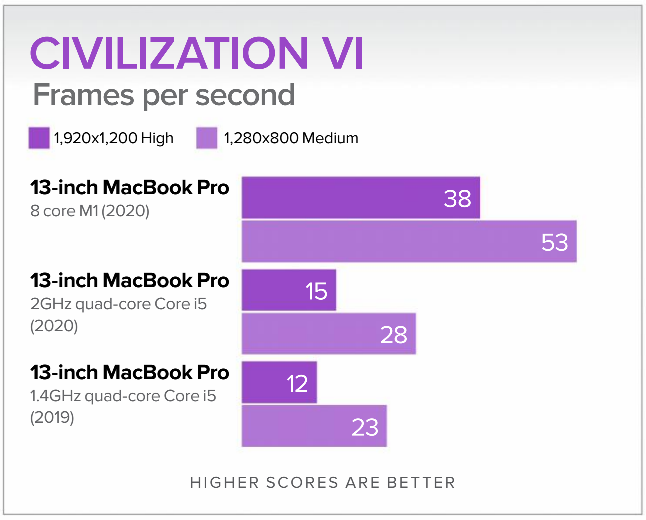




acceptable frame rates. Let's see if the situation has improved.

Mac games with native code for Apple silicon aren't available yet (unless you include iPhone and iPads). But we were curious to see what kind of performance we would get with a couple of Mac games that use code written for Intel processors. We ran *Rise of the Tomb Raider* and *Civilization VI*, and came away impressed. With either low or high quality settings, the M1 MacBook Pro drastically improves upon the graphics speed of the other 13-inch laptops in our testing.

So what about *native* graphics performance? Lacking any optimized games, we used the Compute benchmark in Geekbench 5. And with either OpenCL (go.macworld.com/opcl) or Metal (go.macworld.com/metl), the M1 MacBook Pro provides the graphics boost that users of lower-priced Macs have been yearning for.



IT ALSO *FEELS* SIGNIFICANTLY FASTER

Of course, benchmarks aren't the only way to gauge performance. There's also the palpable feel when you're using a computer. Now, when you've been reviewing Macs for as long as we have, getting a feel for speed improvements is difficult. Usually, we're dealing with a 10 to 15 overall percent speed improvement year over year, and that's difficult to gauge outside of benchmarks.

But this wasn't the case with the M1 MacBook Pro. Everything on the computer has a crisp snap to it, including app launching, and windows opening and closing. In Safari, the speed is even more noticeable, with faster loading webpages and smoother scrolling. When Apple's Craig Federighi demonstrated (go.macworld.com/cfdm) instant wake during the "One more thing" event, it showed me how I've simply accepted the fact that Intel-based Macs don't instantly wake from sleep. While it's only a lag of a few seconds, it's a lag that's now gone on the M1 MacBook Pro.

The key to all these performance increases is using software optimized for the SoC. So, before you buy an M1 laptop, check to see if the software you use most often is available as Universal binaries, meaning they include both Apple silicon and Intel versions. (Some developers may distribute software specifically for Apple silicon.) If your primary apps are Apple

DaVinci Resolve
File
Edit
Trim
Timeline
Clip
Mark
View
Playback
Fusion
Color
Fairlight
Workspace
Help
Tue Nov 10 9:41 AM
Media Pool
Effects Library
Edit Index
Sound Library
Autumn Moods
Edited
Mixer
Metadata
Inspector
Timeline 1
01:00:25:07
V1 Video 1
A1 Audio 1
Intro_Series_1
Reveal_Sequence_V3
Main Theme
DaVinci Resolve 17
MacBook Pro

The 13-inch MacBook Pro can play back full-quality, 8K ProRes video without dropping a single frame.

apps, you're in luck, as Apple has updated its apps to take advantage of the M1.

I did a few application-based tests to determine improvements when using native software on the M1 MacBook Pro compared to the 2.0GHz Core i5 MacBook Pro. In iMovie, I exported a 30-minute video using the default 720p settings to a file. The M1 MacBook Pro finished the job in 132 seconds, much faster than the 218 seconds posted by the 2.0GHz MacBook Pro. I also did a GarageBand export of a 42-minute Macworld Podcast as an MP3 file, and the M1 MacBook Pro finished in 57 seconds, while the 2.0GHz Core i5 MacBook Pro took 82 seconds. And then I did a video conversion in Handbrake, and the M1 MacBook Pro jumped leaps and bounds over the 2.0GHz Core i5 MacBook Pro.

THE 16GB MEMORY CEILING

The M1 is referred to as a "system on a chip." Before the M1, a Mac laptop had several different chips that served different purposes. You would have a chip for the CPU, chips for RAM, controllers, and more. Apple has now combined all those chips into one, the M1 system on a chip (learn more about Apple's M1 chip here (go.macworld.com/lnm1)).

There are many advantages to a SoC, such as better performance and power efficiency, and it takes up less room on a motherboard. But there are also some compromises, such as the inability to upgrade memory. Owners of previous MacBooks are probably used to this, anyway—it's been a while since Apple allowed users to upgrade RAM after initially buying the laptop.

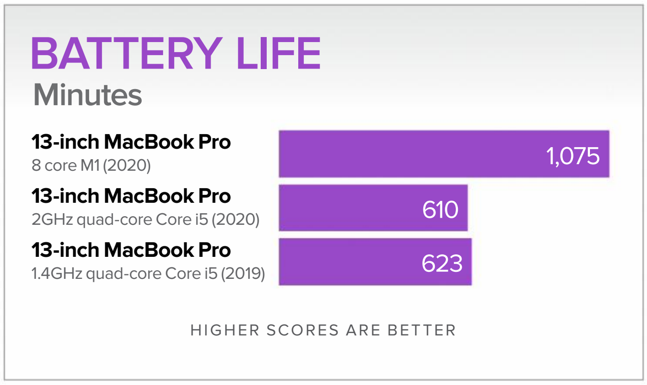
But another compromise is there are currently only two available RAM options: 8GB or 16GB. For many power users, 16GB in what's supposed to be a "pro" machine isn't enough. They'd like at least 32GB. That seems to be one of the reasons why Apple still offers the 13-inch MacBook Pro with Intel chips, as those laptops support up to 32GB of RAM.

Now, there's a possibility that, just as we need to rethink clock speed as other aspects of computer processing, we need to rethink memory. Apple's SoC uses what it calls "unified memory" and developer and blogger Howard Oakley has an interesting article about it (go.macworld.com/hwok). We also have an unified memory explainer by Macworld columnist Jason Snell that goes in greater detail—see page 15. How we think about the amount of RAM needed in a Mac needs to evolve now that the M1 is here.

If you just can't wrap your head around the idea of having only 16GB of RAM, you have two choices: get an Intel-based laptop, or wait. Remember, this is the very first Apple silicon chip for Mac. Sometime in the near future, Apple will likely release a chip that uses more memory. (Apple has not commented on its silicon release schedule and what chips it will include.)

ALL-DAY BATTERY LIFE. REALLY

Besides performance, Apple claims another advantage to an SoC is improved power efficiency. The M1 Mac is better at managing the power it uses, which means better battery life. To gauge how long the battery will last, we ran a video at full screen on a continuous loop until the battery ran out.



Apple states that the battery in the machine we tested will last up to 20 hours playing video. We didn't get 20 hours, but we got darn close with almost 18 hours. The other two 13-inch laptops we tested lasted 10 hours. In the past, we'd gladly take whatever we can get when it comes to battery improvements with the MacBook Pro, usually an extra hour or two. But to see this much improvement, well… it's sort of mind-boggling.

FROM THE OUTSIDE, IT'S THE SAME MACBOOK PRO

The M1 MacBook Pro has the same design, keyboard, and Touch Bar as the Intel-based models they replace—and they're also the same as the parts found on the current, higher-priced Intel 13-inch models. Our opinion of these

The Touch Bar is on all models of the MacBook Pro.

aspects of the 13-inch MacBook Pro hasn't change, so we won't repeat ourselves here. But if you are interested in what we think, take a look at our review of the $1,799 13-inch MacBook Pro (go.macworld.com/rmpr) and check out the sections on the keyboard, Touch Bar, storage, and more.

One major complaint that could be made about the M1 MacBook Pro is that it uses a 720p FaceTime camera. Apple *did* improve its performance though its image-signal processor, but it's still a 720p camera in a world where 1080p cameras should be the norm.

The M1 MacBook Pro fills out the lower-end of Apple's 13-inch MacBook Pro lineup, and these models have only two Thunderbolt/USB 4 ports, both on the left side. If you'd rather have more ports than resort to using a hub, you need to invest in a $1,799 or $1,999 Intel model, which have four ports, two on each side. Or you can wait and see if Apple updates these pricier models with Apple silicon at a later date.

If the FaceTime camera and the two ports aren't enough to temper the excitement, maybe this one issue will: the

M1 MacBook Pro is limited to one external display, which can run at 6K resolution at 60Hz. If you need to attach at least two external displays, you have to get the $1,799 or $1,999 13-inch MacBook Pro models with Intel processors. They can handle two displays running at 4096x2304 resolution at 60Hz. Also, external GPU devices are not supported.

Overall, we like the MacBook Pro design. It's attractive, practical, sturdy, and familiar. But it's a design we've used for some time now. It would've been nice for Apple to introduce something new, though this may be a trite complaint, considering how well the MacBook Pro works.

BOTTOM LINE

I was giddy during the first couple of days using the new 13-inch M1 MacBook Pro, and each time I witnessed another broken benchmark record, my excitement levels rose. Then there's the battery that seems like it could go on forever, even when you're doing serious work. I've seen and tested a lot of Macs—I did testing for MacUser Labs back during the Motorola 68000-to-PowerPC transition, and I even reviewed the first Intel Macs for MacAddict (go.macworld.com/1int). But this… this is something else. This is a revolutionary moment for the Mac.

You need to have software written for Apple silicon to get the speed, but I can understand if you can't sit on the sidelines and wait. Even if your apps aren't Universal yet, they probably will be soon. In the meantime, if you use a non-native app, it will run under Rosetta2 emulation, and the performance is acceptable.

However, there are a couple of other reasons to wait. The first is that this is just the start of the Apple silicon rollout, and Apple's next step could be chips with more RAM, or support for more than two Thunderbolt ports. (This is all speculation. Apple hasn't announced anything.) If those are features you want in a pro-level laptop, then wait.

The second reason to wait is that you work in a production environment and need to connect several devices to the Mac or you use specialized software. If this describes your work situation, check into compatibility before buying.

But if you don't need those features, or you're not in a production setting, then invest now in the 13-inch M1 MacBook Pro. You won't be sorry. ■

●●●●½

13-inch MacBook Pro (M1, 256GB/512GB SSD, Late 2020)

PROS

- Remarkable performance when using native software.
- More than double the battery life over Intel-based models.
- Rosetta 2 performance is better than expected.

CONS

- Only two Thunderbolt 3/ USB 4 ports.
- Still has a 720p FaceTime camera.

PRICE

$1,249 / $1,449

COMPANY

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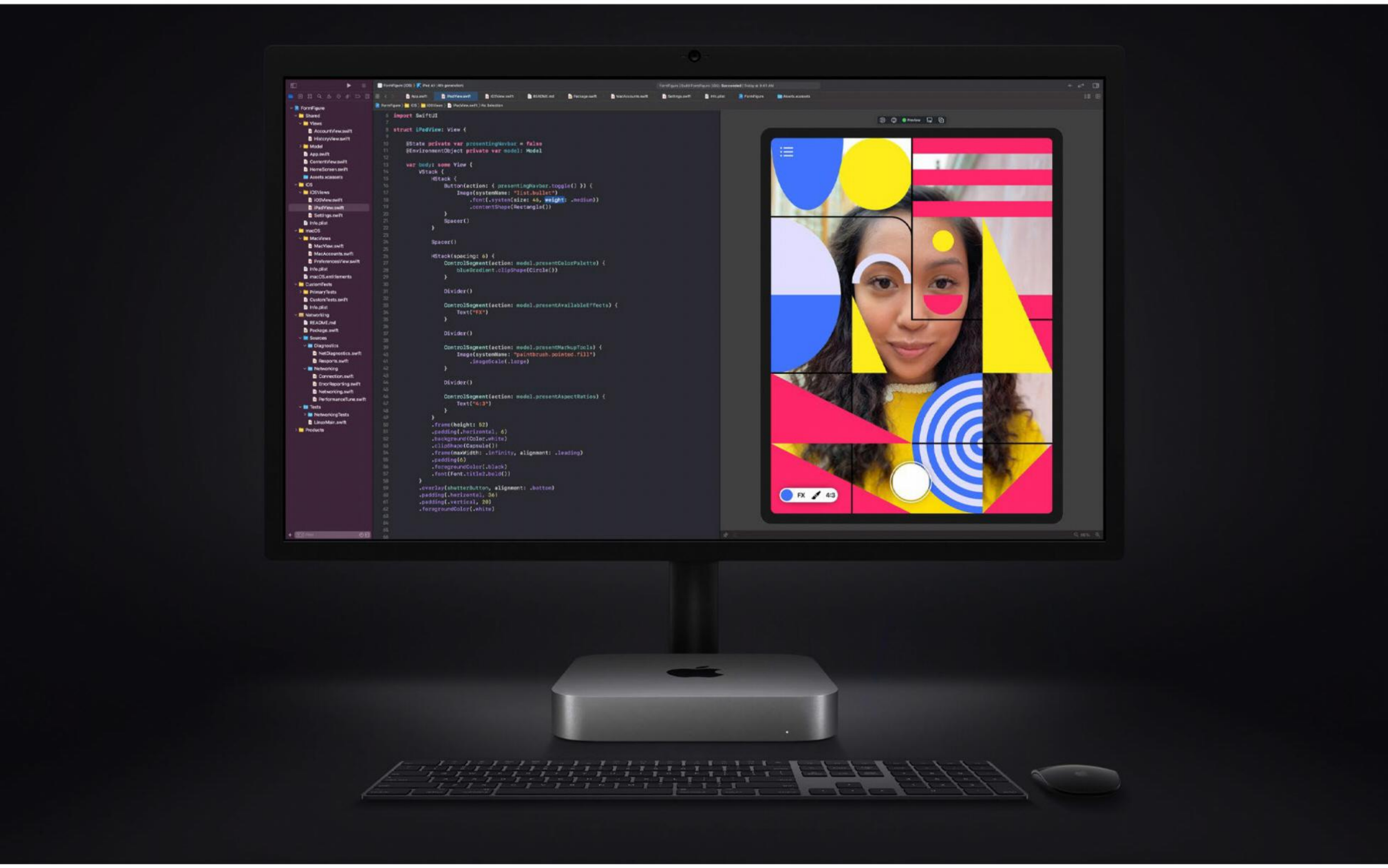
M1 MAC MINI REVIEW: THE MAC WITH THE BEST EVER BANG FOR YOUR BUCK

APPLE'S M1 SOC MAKES THIS DESKTOP MAC A GREAT VALUE.

BY ROMAN LOYOLA

IMAGE: APPLE



Macworld EDITORS' CHOICE

Apple's bestselling Macs are its laptops, the MacBook Air (see page 72) and the MacBook Pro (see page 86). So it seems logical for Apple to debut its new M1 system on a chip (go.macworld.com/lnm1) in these machines. But Apple also decided to use the M1 in the Mac mini. Two years after its last update, the Mac mini became the first desktop Mac to sport Apple's SoC.

After having tested the M1 Mac mini, one thing is perfectly clear: at $699, the M1 Mac mini is a tremendous value. You get so much bang for your buck that it's a little hard to fathom, especially for anyone who has invested in Mac minis in the past. You expect to make compromises in performance for the price being paid. Not here. Not anymore.

This review takes a dive into the $699 Mac mini, which has an 8-core M1 SoC with an 8-core GPU and 8GB of RAM. This model also includes a 256GB SSD.

Before we dive into the performance results, let's talk a little about why this Mac mini is so fast. It's because of the M1.

M1: SYSTEM ON A CHIP

Processor changes are not new to the Mac. In the mid 1990s, Apple switched from Motorola 68000 processors to the PowerPC. In 2005, Apple announced (go.macworld.com/2005) the transition from PowerPC to Intel processors. Now, in 2020, Apple has started the two-year process to switch from Intel chips to its own. But why should you care?

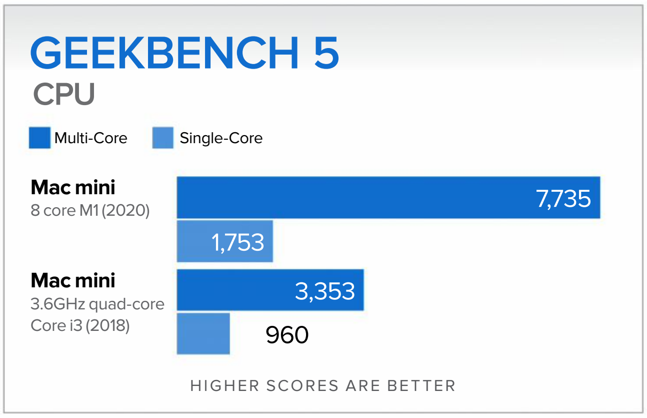
Apple doesn't just switch chips for no good reason. There are a lot of reason why Apple wants to switch, and for you, the user, the reason are good. Apple wants to make hardware and software with features that can't be achieved without fundamental changes. Sure, Apple benefits business-wise by controlling as much as it can, but if Apple really didn't care about the evolution of the Mac (as some longtime users believe, because iPhone), it wouldn't make this change.

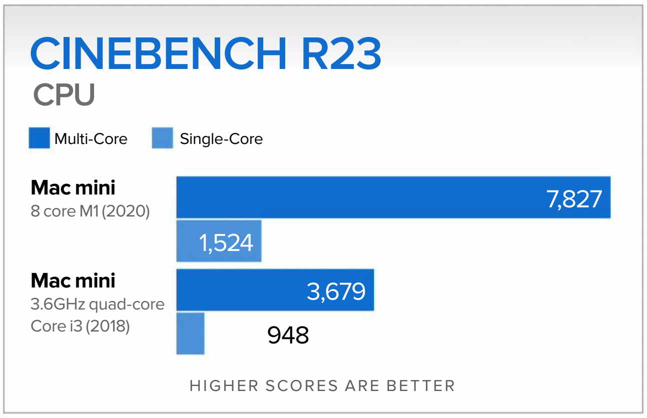
Apple calls the M1 a system on a chip (SoC). Before the M1, Macs had separate chips for the processors, graphics, RAM, controllers, and more. Those components are now brought together on a single chip (the RAM is technically separate chips on the same package). And Apple isn't really new to all of this. They've been making SoCs for the iPhone and iPad for years. If you want to learn more about the M1 and why an SoC makes Macs so fast, read this overview about the M1 SoC. (go.macworld.com/lnm1)

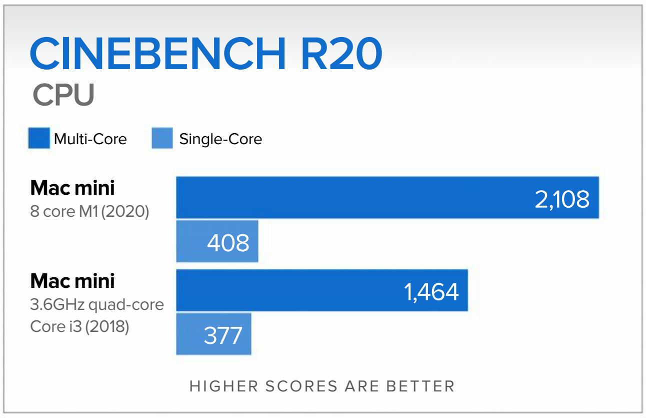
One thing that I should address specifically about the SoC is its memory. The M1 is offered with either 8GB or 16GB of RAM, and if you want 32GB or 64GB, you have to invest in the Intel-based model—or wait and see if Apple will release a SoC with more memory. The amount of memory is a concern for many users, especially for anyone who uses professional production software. In my experience with the 8GB M1 Mac mini, I wasn't able to slow the machine down as I used it in during my typical workday. We have a separate article that explains how memory works in the M1 (see page 15), and that it's time to rethink our memory requirements because of Apple's Unified Memory Architecture.

PERFORMANCE BENCHMARKS

We ran several benchmarks to gauge the performance of the M1 Mac mini. For







comparison, we also tested 2018 3.6GHz quad-core Intel Core i3 Mac mini, which sold for $799 when it was released. This is the Mac that the M1 model replaces in Apple's lineup.

The Geekbench 5 benchmark (go.macworld.com/t2g5) is good gauge for overall performance. The M1 Mac mini nearly doubled the single-core CPU result of the Core i3 Mac mini, and it more than doubled the performance in multi-core testing. The new Mac mini makes the old Mac mini look, well, old.

Another way to gauge performance is by looking at benchmark results from Cinebench R23 (go.macworld.com/cr23). This app does CPU-based ray traced rendering, so while it's of interest to creative professionals, it's a good way to measure performance in a production environment. Again, we see another multi-core result from the M1 Mac mini that's more than twice that of the old Mac mini. The single-core result is impressive, too, with a 60 percent increase.

We turned again to Cinebench in our next test, but this time with version R20, which was written only for Intel processors. In this case, the M1 Mac mini runs the app using Rosetta2, Apple's code-translation software that allows Intel-optimized apps to run on Apple silicon. And it still outperforms the old Mac mini, with a 44 percent increase in multi-core testing! The single-core result is a little more subdued, showing an 8 percent increase.

The benchmarks show that the Mac mini is fast, but even the simple tasks that you do on the computer all the time feel fast. Opening and closing widows, alerts and notifications, and even wake for sleep have a snap to them. Safari benefits a lot from the upgrade to macOS Big Sur and the M1—webpage rendering and scrolling are much faster.

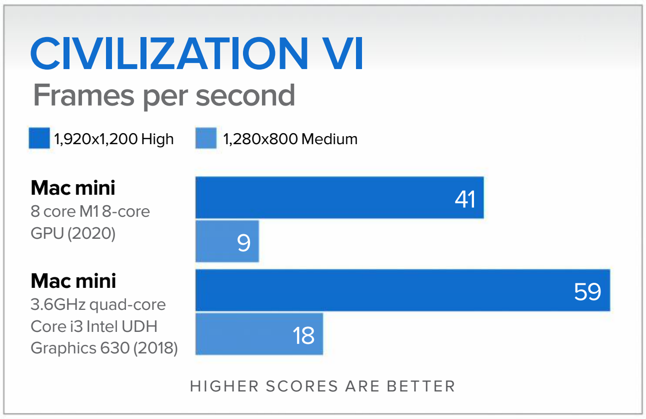
In addition to the benchmarks, I timed a couple of application–based tasks to see what the difference is like. With iMovie, an

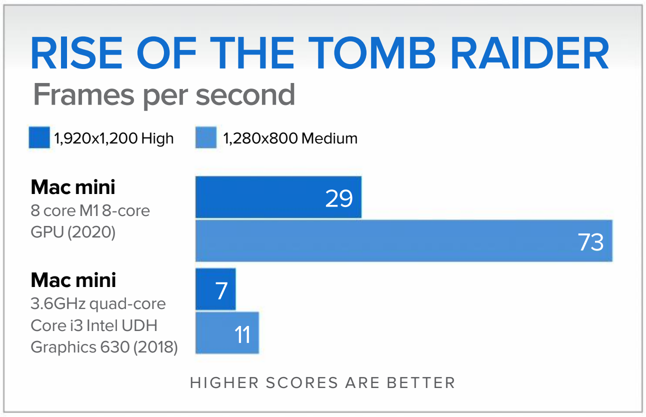
Apple apps such as Logic Pro are optimized to take advantage of the M1.

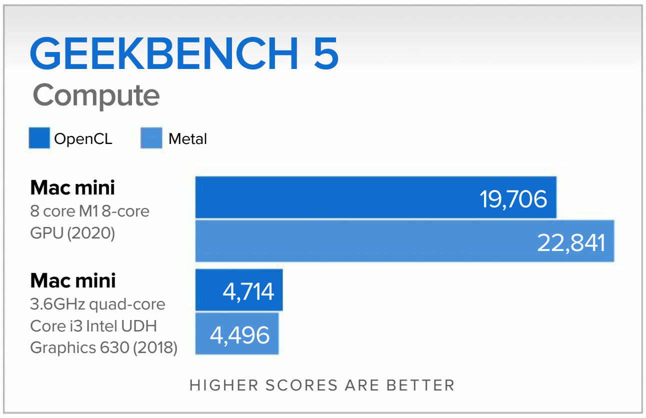
export of a 32-minute video with simple transitions and an opening title took 129 seconds to export as a 720p video file. That same export took what seems by comparison like an excruciating 252 seconds on the old Mac mini. In GarageBand, I did an export of a 42-minute Macworld Podcast to a 256k MP3 file, and the improvement wasn't as big—the M1 Mac mini was 10 percent faster than the old Mac mini.

GRAPHICS PERFORMANCE

A major longtime issue with the Mac mini is that the machine traditionally has been a lackluster graphics performer. It relied on







Intel integrated graphics and provided enough performance for everyday usage, but try to do anything more demanding, and you found out quick that the Mac mini suffered. Apple also didn't update the Mac mini as frequently as other Macs (the last update before this one was in 2018, and that update replaced a four-year old lineup). So over time, as software becomes more demanding, the Mac mini didn't keep pace.

That all changes with the M1 Mac mini. In the tests we performed, the new model is a dazzling graphics performer. And here's the thing: most of the benchmarks we ran were done using non-native applications, and the Mac mini still provides high framerates and scores.

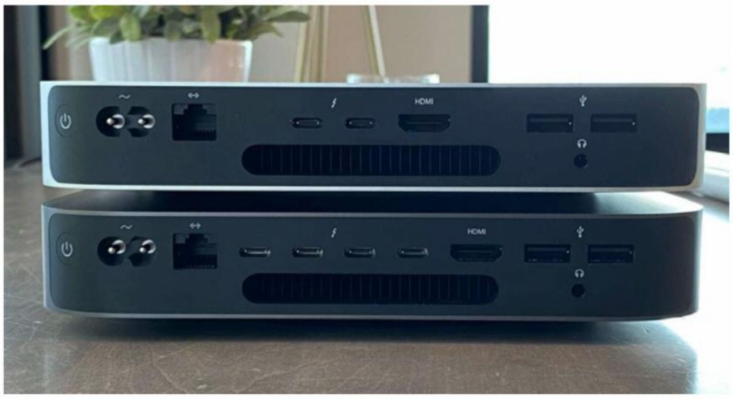
We ran the built-in benchmarks for *Rise of the Tomb Raider* and *Civilization VI*, both of which are running on the M1 Mac mini in emulation. And just take a look at the frame rates in the charts below. I repeat, this is in emulation. The old Mac mini is an embarrassment compared to the M1 Mac mini. Geekbench 5 is a Universal app, and its Compute benchmark tests the GPU, using either the OpenCL or Metal graphics framework. And the results here are comical. The old Mac mini barely even registers compared to the M1 Mac mini.

If you have an old Mac mini, and the CPU performance isn't enough to sway you to upgrade, then these graphics results should give you the final push.

DESIGN, PORTS, AND DISPLAY SUPPORT

Apple didn't change the design of the Mac mini. It still has a compact, aluminum 7.7 x 7.7 x 1.4 case, and its size make it idea for unique situations where space is at a

Apple still offers an Intel Mac mini, which is available only in space gray (left). The M1 Mac mini comes in silver.



The M1 Mac mini (top) has two fewer Thunderbolt/USB-C ports than the Intel-based model (bottom).

premium, whether it is on a desk, used for creative installations, or stacked with other Mac minis for a server farm. But the Apple silicon models are available only in silver, while the Intel-equipped Mac mini comes in space gray.

Besides the colors, there are major differences with the supplied ports. The M1 Mac mini has only two Thunderbolt/USB 4 ports, while the Intel model has four Thunderbolt 3/USB-C ports. You may need a hub for the M1 Mac mini. Both models have an HDMI 2.0 port, two USB-A ports, a gigabit ethernet jack, and a headphone jack.

Another issue with the M1 Mac mini is its display support. Here's what to consider:

M1 Mac mini: Can support up to two displays, one 6K (at 60Hz) display connected to Thunderbolt, and one 4K (at 60Hz) connected to HDMI 2.0

Intel Mac mini:

> Can support up to three displays, with two displays both at 4096x2304 resolution (60Hz) connected via Thunderbolt, and one display at 4096x2160 resolution (60Hz) connected via HDMI 2.0

> Or two displays, one at 5120x2880 resolution (60Hz) connected via Thunderbolt 3, and one display at 4096x2160 resolution (60Hz) connected via HDMI 2.0

Most people use one or two displays, but a good number use three (creative professionals, data analysts). If you can't live without a third display, then the M1 Mac mini isn't for you. You have to get the Intel model.

BOTTOM LINE

The Mac mini is popular because it's Apple most affordable desktop Mac, and also

because its size gives it versatility, making it a good machine to use in a variety of situations. But it was to the low tier of the Mac lineup when it came to performance.

With the M1 system on a chip, that's no longer the case. The new $699 M1 Mac mini blows right past its predecessor, the 3.6GHz quad-core Intel Core i3 Mac mini, and leaves it in the dust. In fact, based on our benchmarks, the new M1 Mac mini's performance mirrors that of the new 13-inch M1 MacBook Pro (see page 86).

It's unfortunate that the M1 Mac mini has only two Thunderbolt/USB-4 ports, which means you may have to buy a hub. And the display limitations may come into play for you. But even with those restrictions, the Mac mini ends up being the best value right now in Apple's Mac lineup. The Mac mini may be small in stature, but it's a giant when it comes to performance. ■

★★★★½

Mac mini with Apple M1 Chip (8GB RAM, 256GB/512GB SSD)

PROS

- Tremendous speed at a bargain price.
- Compact design makes it ideal for any situation

CONS

- Limited display support.
- Two Thunderbolt ports.

PRICE

$669/$869

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How to use a new monitor with an old Mac

A lot of the focus has been plugging old displays into newer Macs, but the reverse is possible, too, if it's got enough ports.

BY GLENN FLIEISHMAN

HDMI
acer
amazonbasics
amazonbasics

While Mac 911 receives a lot of email about connecting Apple's old series of displays to new Thunderbolt 3 Macs via USB-C connections, it's also possible to go the other direction: connect a new "USB-C" monitor to older Macs—so long as the monitor has multiple video ports. (We published a large FAQ (go.macworld.com/lrfq) on what you need to connect old displays to newer Macs.)

Many display makers advertise their newer monitors as "USB-C" models. And there's no backwards compatibility from USB-C, whether that port offers Thunderbolt 3 or just USB, video, networking, and power. No manufacturers have created docks for Thunderbolt 2 that allow a USB-C connection. I'm not sure it's even possible, but there's simply not enough of a market for it if it were.

You can purchase USB-C to Mini DisplayPort adapters, but they don't work in reverse: the host computer has to possess a USB-C controller on its motherboard to bundle the signal correctly from USB-C outward; a display adapter just accepts a signal wrapped in the right format and decodes it.

However, read the specs on a "USB-C" monitor, and you typically find that it also includes DisplayPort (full-sized) and HDMI. For instance, the 1080p 24-inch and 27-inch Dell monitors, P2419HC and P2719HC (go.macworld.com/p241), include USB-C, DisplayPort, and HDMI.

Because these standards incorporate backwards compatibility, you just need to find a way to connect a Mac with Mini DisplayPort or Thunderbolt 2 to a DisplayPort or HDMI connection. (Find the specs for your Mac on the video dimensions it can output, however, to avoid the disappointment of spending the money on a monitor that you have to run at lower resolution than its maximum.)

Mini DisplayPort and Thunderbolt 2 have the same connector type, but are different standards. That's a problem when you try to connect a Thunderbolt 2 hard drive to an older Mac that only has a Mini DisplayPort connection. It won't work. (A rectangle with a vertical bar on each side indicates Mini DisplayPort, while a Lightning bolt signifies Thunderbolt 2.)

However, if you plug a cable directly into an Apple Thunderbolt 2 port, it can be used to drive Mini DisplayPort-equipped monitors, as Apple notes on its lengthy ports page (go.macworld.com/ptpg), a useful read for anyone trying to figure out compatibility across generations of Macs.

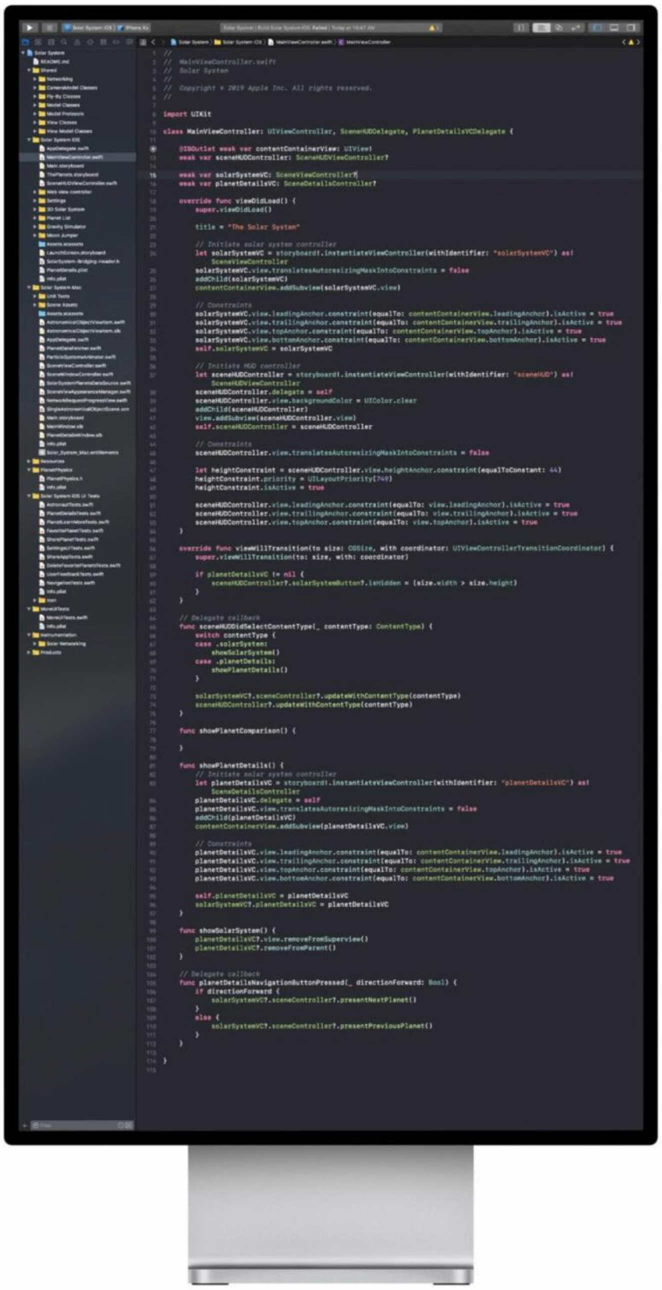
Mini DisplayPort-to-DisplayPort adapter and cables remain readily available. You can purchase something like the AmazonBasics cable ($10.99 for the six-foot version from go.macworld.com/hl00) to plug into a monitor jack. If the monitor has integral DisplayPort cable or you want to more easily swap a DisplayPort cable among devices, you can opt instead for a Benfei adapter ($9.59 from go.macworld.com/benf), which plugs into a Mini DisplayPort jack and offers a female DisplayPort connection.

If you want to use an HDMI connection instead or only have an HDMI port available or free on your monitor, a Mini DisplayPort-to-HDMI cable is also inexpensive. An AmazonBasics six-foot cable is just $10.47 from go.macworld.com/azdp. ■

Need a portrait screen on your Mac? Rotate your display

macOS offers an option on many displays to change orientation.

BY GLENN FLIEISHMAN



```
//
//  MainViewController.swift
//  Solar System
//
//  Copyright © 2019 Apple Inc. All rights reserved.
//

import UIKit

class MainViewController: UIViewController, SceneHUDDelegate, PlanetDetailsVCDelegate {

    @IBOutlet weak var contentContainerView: UIView!
    weak var sceneHUDController: SceneHUDViewController?

    weak var solarSystemVC: SceneViewController?
    weak var planetDetailsVC: SceneDetailsController?

    override func viewDidLoad() {
        super.viewDidLoad()

        title = "The Solar System"

        // Initiate solar system controller
        let solarSystemVC = storyboard!.instantiateViewController(withIdentifier: "solarSystemVC") as! SceneViewController
        solarSystemVC.view.translatesAutoresizingMaskIntoConstraints = false
        addChild(solarSystemVC)
        contentContainerView.addSubview(solarSystemVC.view)

        // Constraints
        solarSystemVC.view.leadingAnchor.constraint(equalTo: contentContainerView.leadingAnchor).isActive = true
        solarSystemVC.view.trailingAnchor.constraint(equalTo: contentContainerView.trailingAnchor).isActive = true
        solarSystemVC.view.topAnchor.constraint(equalTo: contentContainerView.topAnchor).isActive = true
        solarSystemVC.view.bottomAnchor.constraint(equalTo: contentContainerView.bottomAnchor).isActive = true
        self.solarSystemVC = solarSystemVC

        // Initiate HUD controller
        let sceneHUDController = storyboard!.instantiateViewController(withIdentifier: "sceneHUD") as! SceneHUDViewController
        sceneHUDController.delegate = self
        sceneHUDController.view.backgroundColor = UIColor.clear
        addChild(sceneHUDController)
        view.addSubview(sceneHUDController.view)
        self.sceneHUDController = sceneHUDController

        // Constraints
        sceneHUDController.view.translatesAutoresizingMaskIntoConstraints = false

        let heightConstraint = sceneHUDController.view.heightAnchor.constraint(equalToConstant: 44)
        heightConstraint.priority = UILayoutPriority(749)
        heightConstraint.isActive = true

        sceneHUDController.view.leadingAnchor.constraint(equalTo: view.leadingAnchor).isActive = true
        sceneHUDController.view.trailingAnchor.constraint(equalTo: view.trailingAnchor).isActive = true
        sceneHUDController.view.topAnchor.constraint(equalTo: view.topAnchor).isActive = true
    }

    override func viewWillTransition(to size: CGSize, with coordinator: UIViewControllerTransitionCoordinator) {
        super.viewWillTransition(to: size, with: coordinator)

        if planetDetailsVC != nil {
            sceneHUDController?.solarSystemButton?.isHidden = (size.width > size.height)
        }
    }

    // Delegate callback
    func sceneHUDDidSelectContentType(_ contentType: ContentType) {
        switch contentType {
        case .solarSystem:
            showSolarSystem()
        case .planetDetails:
            showPlanetDetails()
        }

        solarSystemVC?.sceneController?.updateWithContentType(contentType)
        sceneHUDController?.updateWithContentType(contentType)
    }

    func showPlanetComparison() {

    }

    func showPlanetDetails() {
        // Initiate solar system controller
        let planetDetailsVC = storyboard!.instantiateViewController(withIdentifier: "planetDetailsVC") as! SceneDetailsController
        planetDetailsVC.delegate = self
        planetDetailsVC.view.translatesAutoresizingMaskIntoConstraints = false
        addChild(planetDetailsVC)
        contentContainerView.addSubview(planetDetailsVC.view)

        // Constraints
        planetDetailsVC.view.leadingAnchor.constraint(equalTo: contentContainerView.leadingAnchor).isActive = true
        planetDetailsVC.view.trailingAnchor.constraint(equalTo: contentContainerView.trailingAnchor).isActive = true
        planetDetailsVC.view.topAnchor.constraint(equalTo: contentContainerView.topAnchor).isActive = true
        planetDetailsVC.view.bottomAnchor.constraint(equalTo: contentContainerView.bottomAnchor).isActive = true

        self.planetDetailsVC = planetDetailsVC
        solarSystemVC?.planetDetailsVC = planetDetailsVC
    }

    func showSolarSystem() {
        planetDetailsVC?.view.removeFromSuperview()
        planetDetailsVC?.removeFromParent()
    }

    // Delegate callback
    func planetDetailsNavigationButtonPressed(_ directionForward: Bool) {
        if directionForward {
            solarSystemVC?.sceneController?.presentNextPlanet()
        }
        else {
            solarSystemVC?.sceneController?.presentPreviousPlanet()
        }
    }

}
```

I remember visiting a college in 1985 (readers, I'm that ancient), and seeing the height of glamor and magic: a portrait-orientation CRT screen that was part of a typesetting system. Because type was composed in "galleys," long runs of relatively narrow columns, someone entering copy could more easily see a long run of text this way.

Computers have come a long way, but this orientation remains the same. You may wind up with a lot of tasks that are better suited for a long vertical, like long runs of text that you're writing, lots of lengthy

IMAGE: APPLE

menus or a huge array of palettes, or material that stacks well in wide rectangles from top to bottom for reference, like resized windows.

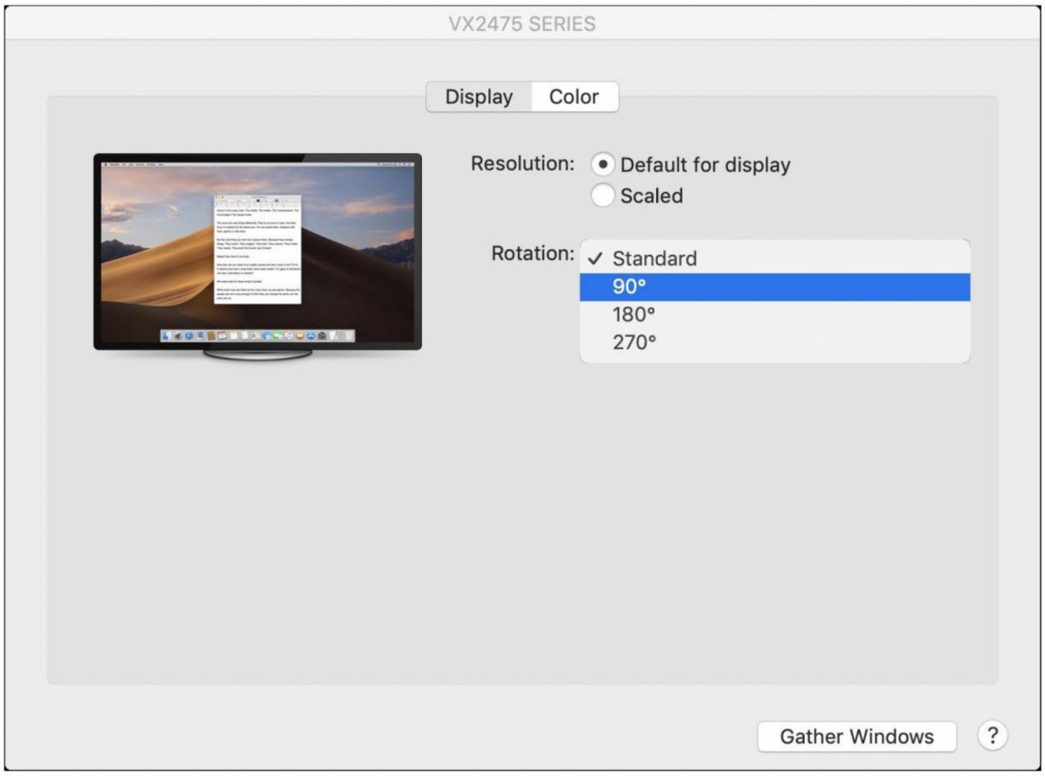
Long ago, you had to rely on drivers or third-party software to rotate a monitor's display, but Apple added it to its Mac operating systems long ago. It's not precisely hidden—though it can be, more in a moment—but it may be something you never considered.

Some monitors even include a rotation joint where the display meet its stand. I recall accidentally partially rotating a monitor a few years ago that I didn't know had such a joint and thought I'd broken it for a moment!

In most cases, you should be able to open the Displays preference pane and if macOS supports rotation on a monitor, a Rotate or Rotation menu appears in the Display tab, with options that can vary by version of macOS and display features. Apple notes mysteriously (go.macworld.com/mysy), "If you don't see the pop-up menu, your computer doesn't support this feature." It doesn't maintain a list of which Macs have or don't have it. iMacs don't appear to support native rotation.

On older versions of Mac OS X and macOS, you may need to open System Preferences and while holding down Command and Option click the Displays item to force a rotation menu to appear.

If your Mac won't rotate its internal display or external displays, SwitchResX ($16 from go.macworld.com/swrx) may be able to help. ■



Resolution: ● Default for display ○ Scaled

Rotation: ✓ Standard
90°
180°
270°

The Rotate or Rotation menu appears for the combination of Mac and display that can support it.

Monitor won’t rotate? You might be able to use a replacement stand

Your Mac might be able to rotate your display in software, but what if you hardware is fixed in place?

BY GLENN FLIEISHMAN

On the heels my the previous column (see page 109) about macOS’s built-in option for rotating a monitor from landscape to portrait display via the Displays preference pane (or third-party software), some readers noted their monitors lacked a physical component.

Some monitor display stands include a rotation joint, and can also extend themselves higher to allow the screen to be at the correct elevation in portrait view. However, you may never have considered that as an option to look for when buying a monitor. You may be able to retrofit rotation, however, by using the VESA hardware interface found on the back of many monitors and some computers, or by adding a VESA adapter if your device lacks it.

Monitors and all-in-one integrated computer displays that support VESA have four screw holes at precise distances in a rectangular pat0tern. You may have never noticed this if you’ve never used anything but a stand that comes with your display or that’s built in. Some monitors use VESA for the stand that’s supplied.

IMAGE: HEMUDU

A huge number of VESA-compatible stands or adapters that work with a variety of stands are in the marketplace. For instance, this adapter and stand (go.macworld.com/hmdu) ($31.95 from), can tilt (forward and back), swivel (around its base), and rotate up to 360° around the screen's access. These stands come with the screws that connect a plate to the VESA-compatible screw holes. (You can also get VESA swing-arm mounts like the kind you've probably seen in doctor's offices.)

Many Apple monitors and its iMac series were sold with a stand that could be removed and replaced with an Apple-designed VESA adapter that provided the standard spaced screw holes. The adapter worked with any VESA stand that could support its weight. Apple no longer sells adapters for old displays and iMacs, but third-party versions are available, like this HumanCentric one (go.macworld.com/hmcn) ($31.99) that works with several Apple displays and iMacs; the same company also offers versions for the large Cinema displays and an extra-clever solution for iMacs that have non-removable stands.

New iMacs can be purchased in special VESA versions (go.macworld.com/vsvr). The new Pro Display XDR doesn't come with a mount (go.macworld.com/apxd), and you can pick an Apple stand or VESA adapter as an option. ■

HumanCentric's stand works with Apple displays.

How to find a monitor that pivots for portrait perfection

Retailers don't make it simple to find which displays can rotate around their axis.

BY GLENN FLIEISHMAN

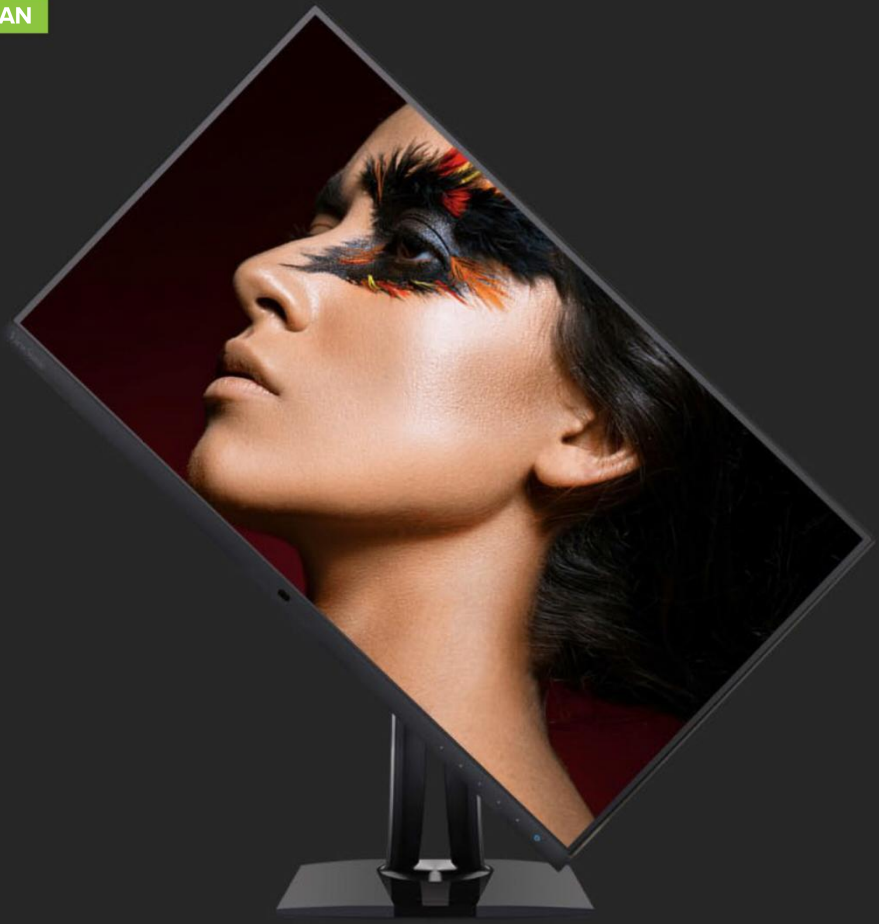


IMAGE: VIEWSONIC

Poking at portrait orientation of monitors attached to your Mac definitely scratched an itch for some readers, based on the mailbag. You can read the original column (see page 111) on how to use the Displays preference pane in macOS or a third-party utility that works where macOS doesn't, and a follow-up (see page 113) on using the standard VESA mount to attach some monitors and Macs (in some cases requiring an adapter) to a more versatile display stand that includes a rotating joint for switching easily from landscape to portrait.

But one reader went shopping for a monitor that included a stand that could rotate and came up empty with online retailers. It's easy to tell with a display you already own whether it can rotate or not: look at its stand or try to turn it. (This does remind me uncomfortably of Homer Simpson trying to pull out a sofa bed from a couch and tearing fragments from it before remembering that *this* couch didn't have a pull-out bed.)

The answer is to start at manufacturers' sites and learn the lingo. In monitor-land, my use of "rotation" is imprecise, as it can describe any of several ways in which a monitor and its stand may move relative to each other. The four different properties are:

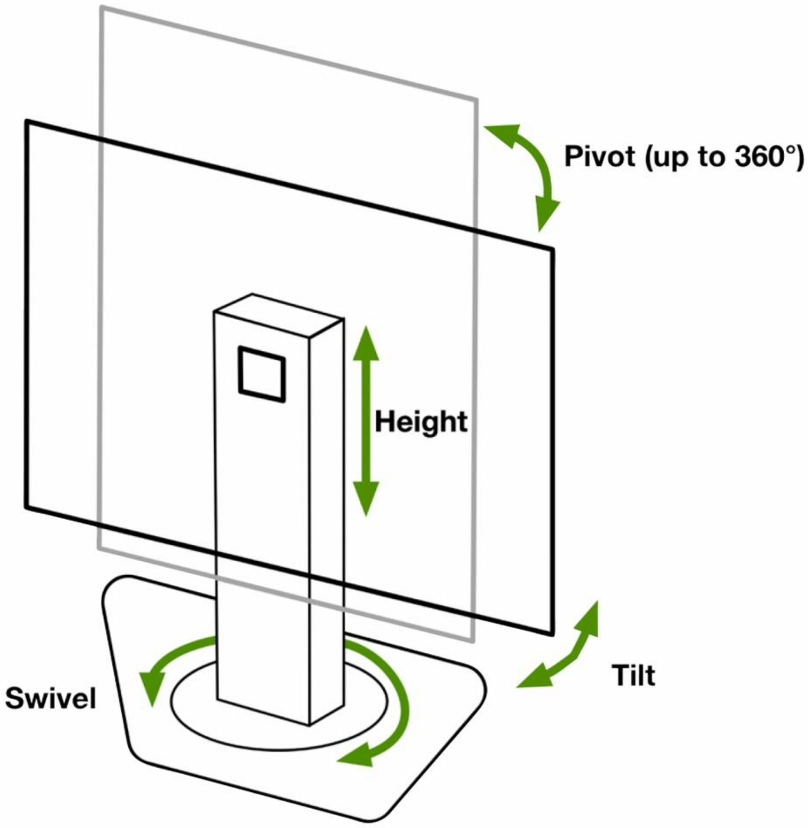
Swivel: Rotation relative to the base, so you can keep the base where it is and rotate the screen around it. The rotation might occur at the base or it might be at the top of the arm on which the monitor connects to the base. This is useful if you need to turn a monitor to show someone else what you're looking at and don't want to reposition its base.

Height: Extending the monitor up and down from the base, typically with a telescoping arm connected to the base.

Tilt: Shifting the plane of the monitor that you're view at an angle away from you or towards you. This is useful to find a non-reflective angle or one that's best relative to where you sit or stand while using it.

Pivot: Rotate the monitor as it faces you around its axis from landscape to portrait, and often many positions in between, and sometimes as much as 360 degrees. That's the one I'd refer to as a "rotation joint," but it's not how the industry defines it.

I find the easiest way to locate which



A monitor stand can shift a display across four different kind of movement.

ViewSonic has a wide selection of models for you to choose from.

monitors include at least a 90-degree pivot, if not other rotation features, is to visit major monitor manufacturers' websites. There aren't that many, and they include Dell, LG, Samsung, and ViewSonic. You can find other brands you might be interested in at online retailers.

At the site, there's usually a way to list and filter monitors, including by feature. ViewSonic offers a store with these features, but you don't have to shop there. Drill down from its Products listing (go.macworld.com/clmn) by clicking Monitors in the left-hand navigation bar, click Shop All, then click Portrait / Landscape (Pivot) in the left-hand navigation bar. This reveals (at present) 25 models that match.

If you want to purchase a monitor that's VESA compatible, per my other column, you can also use a manufacturer's site to find such monitors or ensure compatibility. ViewSonic has a filter in its monitor listing for "100 x 100 mm" (the primary VESA mounting dimensions), which currently has 100 matches against products it offers. ■

Your old monitor looks blurry? It's a retina (or lack of it) issue

Old monitors look terrible compared to modern ones, so much so you might think something's wrong.

BY GLENN FLIEISHMAN

Display technology, just like nearly all technology, has advanced in leaps and bounds over the decades. A monitor just a few years old may look crummy compared to modern ones. But that's especially true when you cross the "retina" boundary. Some readers have thought they had broken monitors or ones that were missing a feature, when it's really that their eyes have been retrained by modern displays.

IMAGE: APPLE

The first Retina MacBook Pro was released in 2015.

For a long time, monitors and laptops had a dot pitch—the numbers of pixels per inch—in the 72 to 96 range, a limitation on affordable cathode-ray tube (CRT) displays. We used that pitch and we liked it, even though screens looked a little jaggy. These older displays had limits on both maximum brightness and the related contrast ratio, which measures the display's range from darkest to brightest. Early LCD monitors improved image aspects and other elements—like being able to view without being nearly square on—but initially remained mostly lower pitch.

Enter Apple Retina displays, first on mobile devices, then on iMacs and laptops, and later on monitors. (Apple sold the MacBook Air in its non-Retina form for a long time; it wasn't until it reintroduced the series in 2018 that it finally took them to Retina pitch.) Apple wasn't the first with high-pitch displays—though it was *very* early on the mobile side—but it tried to fight competition across all platforms by setting Retina as the bar.

There's no formal definition for Retina—or HiDPI (high dots per inch) or other terms—but it's typically about four pixels for every one in a non-Retina display. For all current Apple laptops, iMacs, and the Pro Display XDR monitor, that's right about 220 ppi (go.macworld.com/rtds). (Brightness and contrast ratio is also generally much better than in the pre-Retina days across all but the least-expensive monitors from any manufacturer.)

Once you saw Retina, you might have a hard time going back. I intentionally avoided looking for extended periods at a high-pitch iPad or MacBook Pro, because I feared when I returned to my existing devices, their pixels would look like

All of Apple's MacBooks have a Retina display.

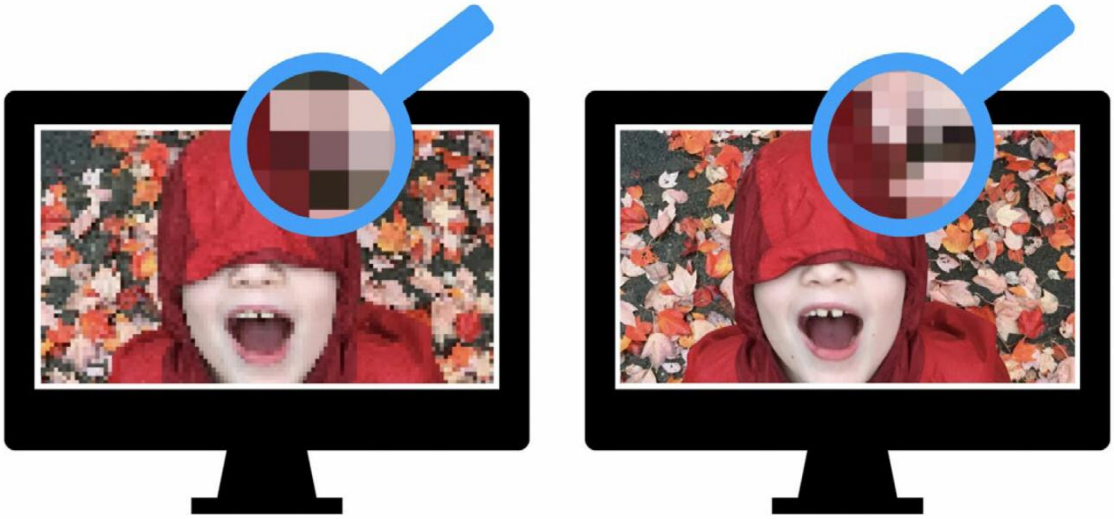
Minecraft blocks.

To consider the difference in concrete terms, one reader wrote in comparing an Apple 27-inch LED Cinema Display (2560×1440 pixels, 109 ppi) with their 2017 13.3-inch MacBook Pro (2560x1600, 227 ppi). Those are nearly the same total numbers of pixels—just under 4 million.

But the area is vastly different, hence the different pitch: the laptop screen covers 80 square inches (513 sq. cm), while the LED Cinema Display comprises 328 sq. in. (2.11 sq. m). Side by side, this makes the non-Retina display's pixels look *enormous*.

A more direct comparison would be between the 27-inch LED Cinema Display and a 27-inch iMac 5K, which sports a 5120-by-2880 pixel internal display—nearly 15 *million* pixels compared to the sub-4 million across the same area of display.

It's no wonder the LED Cinema Display seems blurry and chunky, but don't blame it. Monitors matured, though they likely won't increase much further, as Retina displays—especially the even higher densities in upper 200s to low 400s on iPhones and iPads—really do approach or exceed our eyes' ability to perceive the individual dots. ■



A simulation of non-Retina and Retina displays side by side.

Anker Soundcore Rave Neo: Fat, punchy bass for the dance floor

Flashy lights and kickin' low-end output highlight this Bluetooth speaker that can simulcast with hordes of its brethren.

BY JON L. JACOBI

If you're looking for a speaker to inspire wholesale shuffling at your next party, then Anker's $99 Soundcore Rave Neo is just what you're looking for. It's loud with a tight, thumpy low end that will promote all sorts of rhythmic action and thoughts. (It had my roommate Bridget dancing in zero seconds flat).

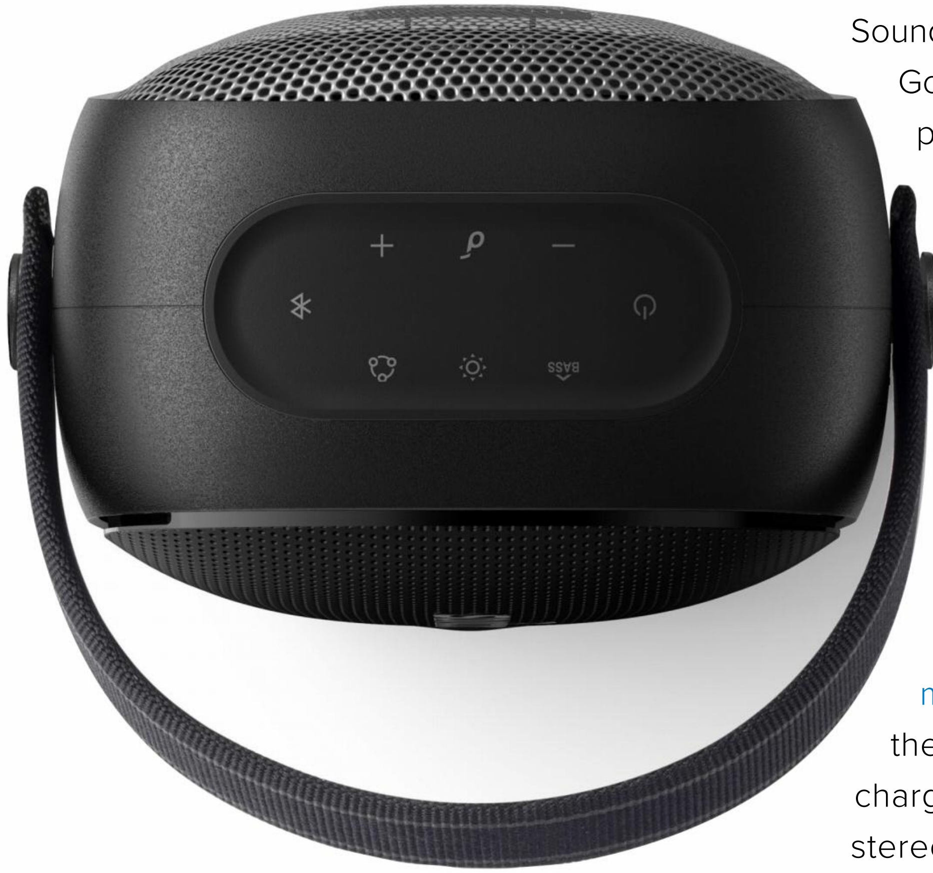
Audiophile, it's not, but that's not its gig and the Rave Neo renders the desired effect when in its element.

IMAGE: ANKER

DESIGN AND FEATURES

The Soundcore Rave Neo is an upright, monophonic speaker that measures a little more than 11 inches tall, about 5.5 inches at its thickest, and roughly 7 inches wide. It weighs in at a little less than 7 pounds, but an easy-on-the-hands, fabric-covered strap makes for easy toting.

The controls for the Rave Neo are on top of the unit as you can see in the above product image. There's the usual volume up/down, Bluetooth pairing, and power buttons, plus a toggle for the bass boost. Also on hand is the link button for PartyCast, which will link the Rave Neo with up to 100 of its ilk.



Anker's Soundcore Rave Neo viewed from above.

There's a button to change the patterns produced by the RGB LEDs circling the 4-inch woofer (there's a 2-inch full-range driver and passive radiator as well), and a very unusual icon (between the plus/minus) representing a multi-function play/pause/previous/next button.

Anker includes a "universal" one-picture-is-worth-a-thousand-words type manual for the Rave Neo, but it could be a lot clearer and was incomplete. For instance, it didn't cover changing between the three EQ modes (done via the Soundcore app) or how to invoke the Siri/Google phone function at all. I had to peruse the Anker's website about the first, and discovered the latter (super long press on the weird icon) by sheer luck.

The Rave Neo is rating IPX7 for protection from water, meaning you can submerge it in the kiddie pool (up to one meter) for up to 30 minutes (you can read more about IP ratings and what they mean in this story [go.macworld.com/ipra]). To that end, the USB-C charging port, USB Type-A charge-other-stuff port, and 3.5 mm stereo auxiliary input are hidden beneath a captive rubber plug on the back of the unit.

SOUND

The Soundcore Rave Neo might be the most aptly named speaker I've run across. It's designed for parties, where volume and bass count for more than uber fidelity. Viewed (and listened to) from that perspective, it's a good speaker.

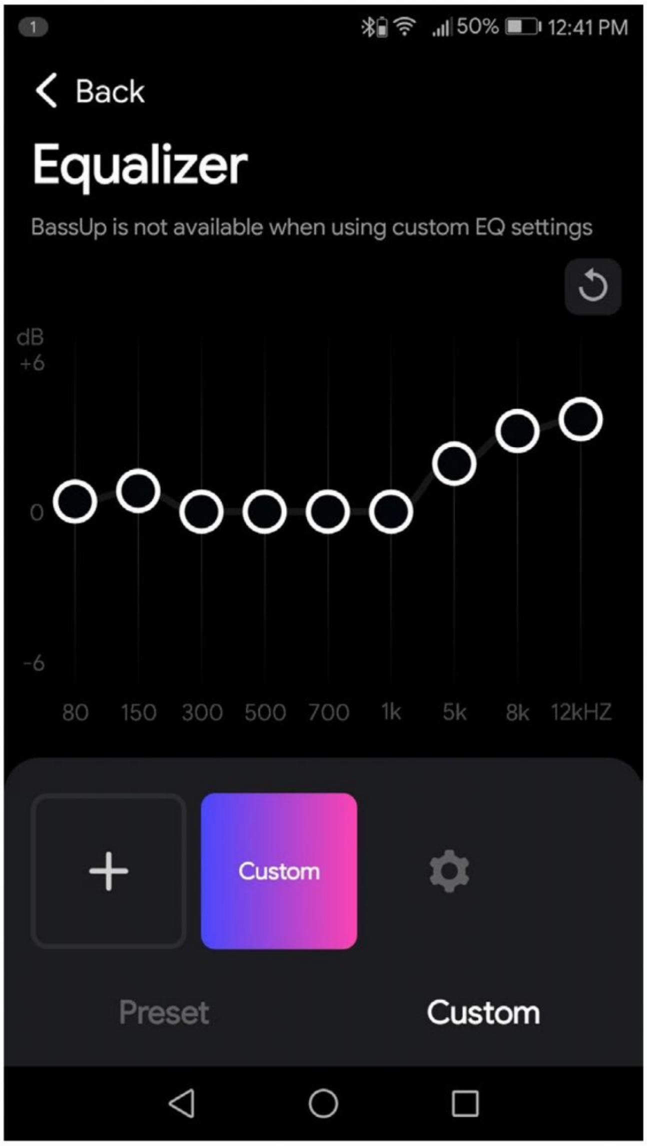
The Rave Neo's best trick by far is its tight, pumping bass. Anker nailed it, and the section of the mid-range it accentuates is the one most likely to cut through crowd noise, wind, and other ambient stuff.

As usual, I threw a variety of genres at the speaker, and I wasn't impressed until I cranked it up and hit the EDM (Electronic Dance Music) and hip hop selections. At that point, it came to life.

Employing the EQ in the Soundcore app made a huge difference for quieter types of music, though it couldn't compensate fully due to an overall slight lack of high-end sparkle, somewhat weak upper mid-range definition, and the absence of stereo separation. Quiet contemplation isn't really the Rave Neo's thing. That said, with the default "outdoor" EQ setting, the portion of the mid-range that cuts through crowds and other noise is definitely there.

I left the bass boost engaged for the most part, and used the EQ to dial it back as necessary.

Battery life was just around the claimed 18 hours at the lower volumes I used, but will decrease as things gets louder. If you're going to party hard for that long, you'll need an AC outlet.



BassUp is not available when using custom EQ settings

The EQ in the Soundcore APP (Android shown) helped boost high-mid to treble frequencies that were missing from the Outdoor preset.

Anker also sent me a smaller Soundcore Flare 360 speaker ($69) to test the PartyCast feature that it and the

The Soundcore Rave Neo is designed for parties, where volume and bass are important.

Rave Neo share. The Flare 360 has much better high-frequency performance and stereo separation, but weaker bass. The pairing was far more satisfying sonically than either speaker on its own.

Note that PartyCast linking was easy, but that no sound issued from the Flare 360 until I boosted the volume on the Rave Neo. The lack of emanations consternated me for a good half hour.

Anker Soundcore Rave Neo

PROS

- Gets loud without noticeable distortion.
- Very tight and prominent low end.
- RGB party lighting.

CONS

- Slightly muddy upper mids and high end.
- No stereo separation.

PRICE

$99

COMPANY

Anker

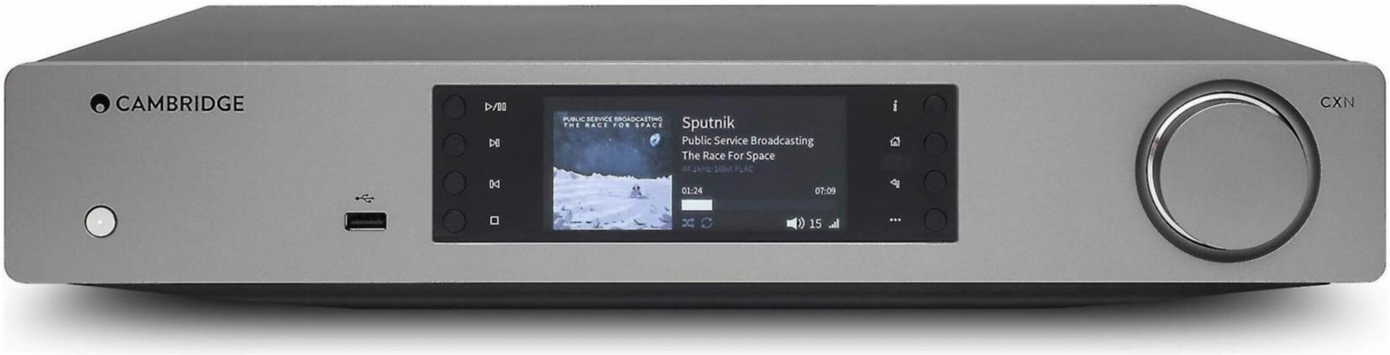
BOTTOM LINE

As it will likely be used under conditions where the relative lack of sparkle and upper-range definition won’t matter, the Soundcore Rave Neo is on point for its mission: loud, throbbing, dance music delivery. Buy it for that. And if you want a nicer sonic experience, pair it with the Soundcore Flare 2. ■

Cambridge Audio CXN (v2) network audio streamer: This is a high-tech musical powerhouse

Support for every audio-streaming protocol and service you can think of, prodigious connectivity options, and sweet sound make for a best-in-class audio component.

BY THEO NICOLAKIS



Macworld EDITORS' CHOICE

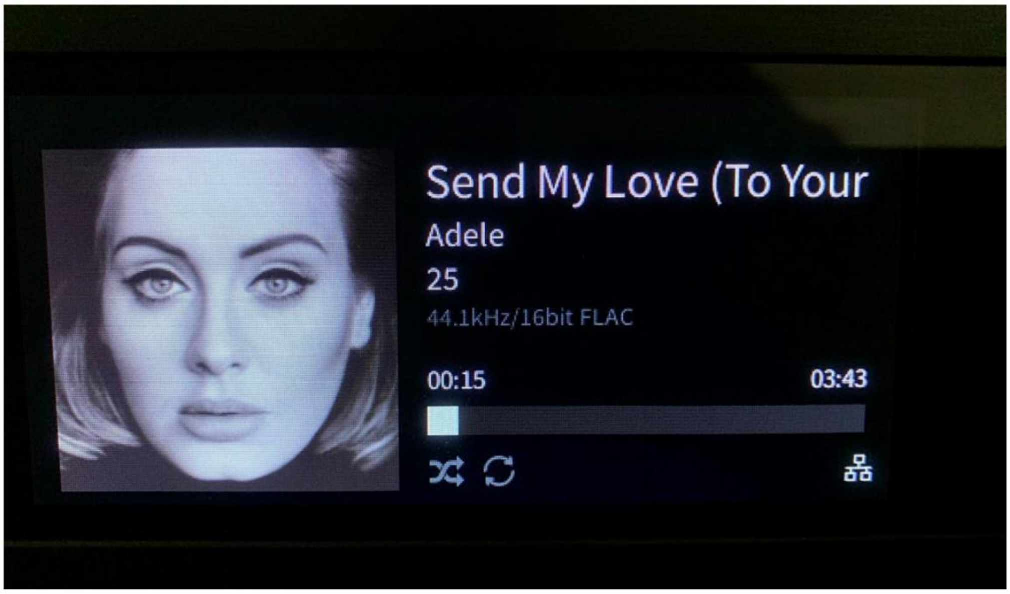
A network audio streamer is designed to serve as a central hub for all your digital audio sources. Cambridge Audio's $1,099 CXN (v2) network audio streamer is arguably among the best you'll find. The CXN (v2) marries a super-rich feature set, copious connectivity options, broad support for multiple ecosystems, and solid audio performance into a near-perfect package that will fit into just about any scenario.

Even better, regular firmware updates promise to add features and functionality, making for an investment that you'll enjoy for years to come.

BUILT FOR HIGH-PERFORMANCE AUDIO

The CXN (v2) is designed to sit at the heart of a high-performance audio system. It's sculpted design and brushed metal accents make this a piece you won't mind putting on display front and center.

The unit's front panel display would be killer if it was an OLED panel. You'll instead have to settle for a pretty-good LCD display that I found to be crisp, sharp, and good enough to get the job done. Tactile buttons flanking the LCD display are clearly and intuitively marked. The large knob on the right helps you fly through menus while pressing on the knob selects


Send My Love (To Your
Adele
25
44.1kHz/16bit FLAC
00:15
03:43

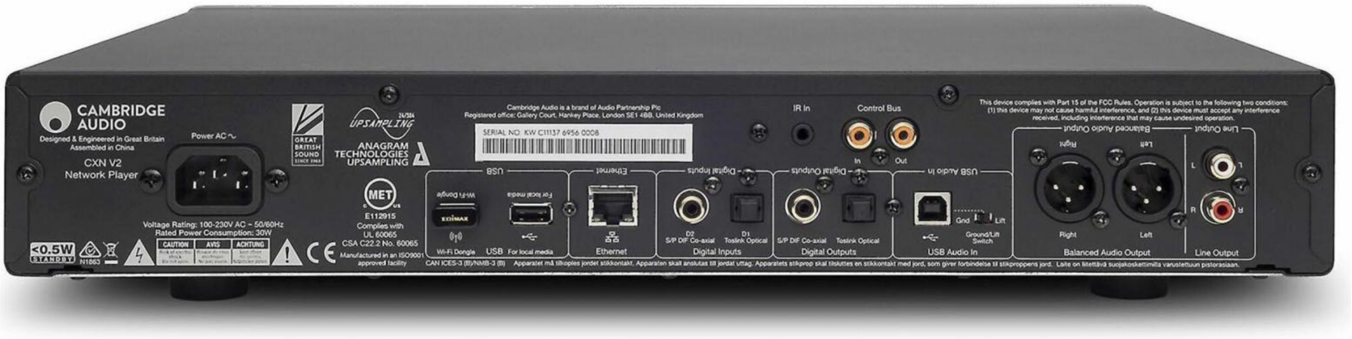
The Cambridge Audio CXN (v2) doesn't have a huge display on its front panel, but it conveys a lot of information in the space afforded to it.

the highlighted menu item.

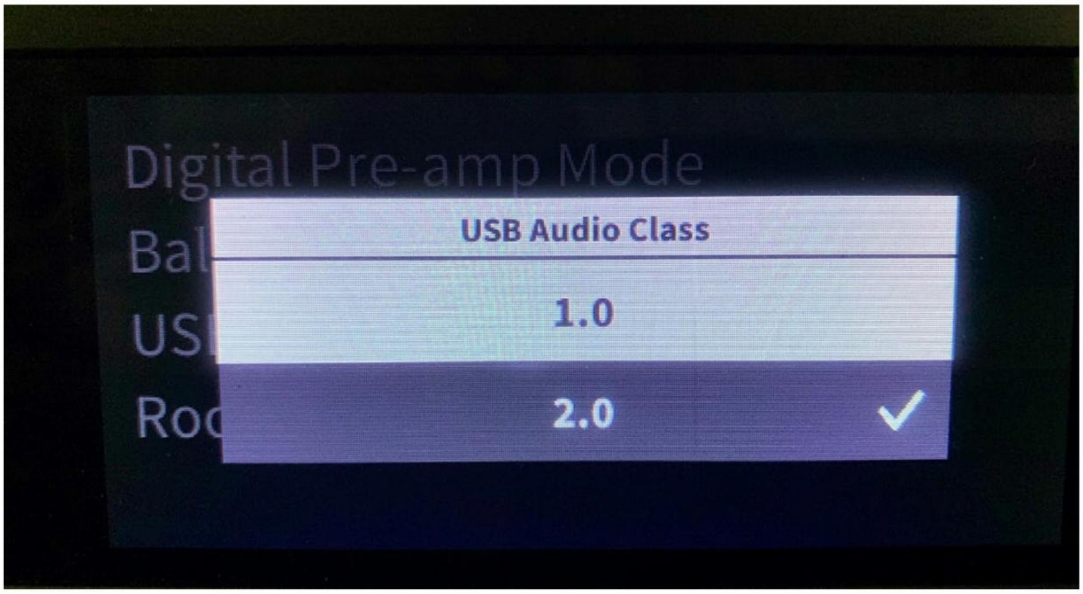
Flexible input and output options abound. Pick from sources featuring S/PDIF coaxial, Toslink optical, USB Audio, or attach plain-ol' USB storage. Use the CXN (v2) as a USB audio device, and you can manually choose between USB Audio Profile 1.0 or 2.0 as well.

In addition to S/PDIF coaxial and Toslink Optical (which are concurrently active), you'll find unbalanced analog output and balanced (XLR) stereo output. Those with high-end audio gear crave components with balanced connections due to their ability to reject cable-borne noise and interference. The only output you won't find is HDMI, which frankly is no big deal.

The Cambridge Audio streamer is built for two-channel bliss. You'll be able to achieve full 24-bit/192kHz output from the CXN (v2)'s S/PDIF coaxial output. Analog outputs take advantage of the CXN (v2)'s dual 24-bit Wolfson WM8740 DACs.


CAMBRIDGE AUDIO
CXN V2
Network Player
Power AC
IR In
Control Bus
USB
Ethernet
Digital Inputs
Digital Outputs
USB Audio In
Balanced Audio Output
Line Output

The Cambridge Audio CXN (v2) offers copious input and output options, including a control bus for integration with sophisticated multi-room audio systems. Also, note the inclusion of balanced analog audio outputs.



You can select between USB Audio Profile 1.0 or 2.0 via the CXN (v2)'s menu.

For a unit of this caliber, I view Bluetooth as a convenience instead of a feature. Cambridge Audio must see it that way, too. If you really want it, Cambridge Audio offers an optional adapter, the BT100, that supports aptX for better-quality streaming. It won't take you into the realm of high-res streaming, though, because it doesn't support aptX HD. Should Bluetooth be important to you, note that the adapter that occupies one of the USB ports that could otherwise be used to host a storage device.

Onboard 10/100 ethernet provides a stable connection to your home network. While the techie in me would like to see a gigabit ethernet connection, a stable 10/100 connection is more than adequate for streaming even very large high-res files. If your home doesn't have the infrastructure to support wired connections, Cambridge Audio offers an optional Wi-Fi adapter. I always recommend using a wired connection due to its stability and speed.

LOTS OF TRICKS UP ITS SLEEVE

Cambridge Audio's CXN (v2) is an incredibly well thought out and flexible unit that can be integrated into a broad array of ecosystems, including both Google's Chromecast and Apple's AirPlay 2. The more time I spent with the CXN (v2), the more thoughtful features I discovered. There's a ground-lift switch next to the USB Audio input for example; that's a really smart feature for defeating any ground loop that might emanate from you speakers when you connect a computer or NAS box to the streamer.

While the CXN (v2) is billed as a network audio streamer, it can also function as a full-blown digital preamplifier. Turn on the digital preamp function and voila! The navigation dial on the right side instantly doubles as volume control. Pair the CXN (v2) with a high-quality stereo power amplifier, connect a pair of killer speakers, and you'll find yourself armed with a compact powerhouse of a system at a modest overall cost.And the tricks don't stop there. Homeowners with complex multi-room control systems—or the custom installers they hire to put those types of systems in—will love that the CXN (v2) has a dedicated control bus and can send and IR commands via a port on the unit's rear panel.

But the CXN (v2)'s upgradeability via firmware might be its best feature of all. You might think of device as a personal computer optimized for audio. Whenever new features and services come out, Cambridge Audio can upgrade this machine to offer them. Since its original launch, the company has added Tidal and Qobuz integration, Chromecast and AirPlay 2 support, and—most recently—the company has rendered its streamer Roon Ready (you can read our early Roon review here (go.macworld.com/rnrv), and its latest features here (go.macworld.com/ltft). All of that comes on top of its UPnP compatibility, Spotify Connect support, and internet radio features (don't miss our iin-depth, two-part guide to internet radio [go.macworld.com/inrd]).

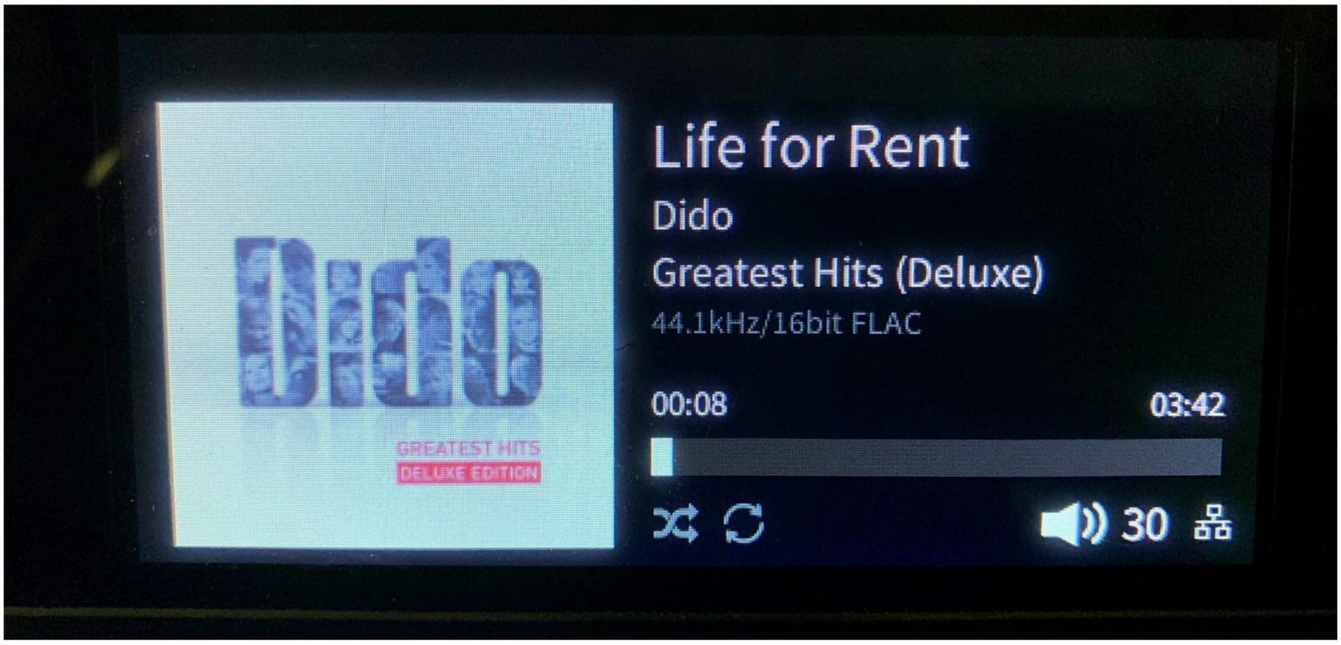
FITS SEAMLESSLY INTO ANY STREAMING ECOSYSTEM

I run a mixed protocol environment, and the CXN (v2) was comfortable with all of it. Firing up AirPlay 2, I easily streamed to the CXN (v2) from any iOS device or grouped it along with my Denon X8500H and Apple TVs for whole-home audio. Alas, Apple still doesn't support high-res streaming over AirPlay 2 (call this a sincere shout-out request, Apple).

Balance
US
Roo
Roon Ready DSD Mode
Use DoP for digital output ✓
Use PCM for digital output

Cambridge Audio's CXN (v2) Network Audio Streamer supports the Roon music server with its latest firmware update.

The CXN (v2) came up as a native Chromecast client, too. Adding the CXN (v2) to my Google Home app, I created a speaker group with Cambridge Audio's



The CXN (v2)'s LCD screen displays album art, title, artist, format, and more.

other standout, the Yoyo (L) streaming speaker, and Definitive Technology's Studio Slim soundbar.

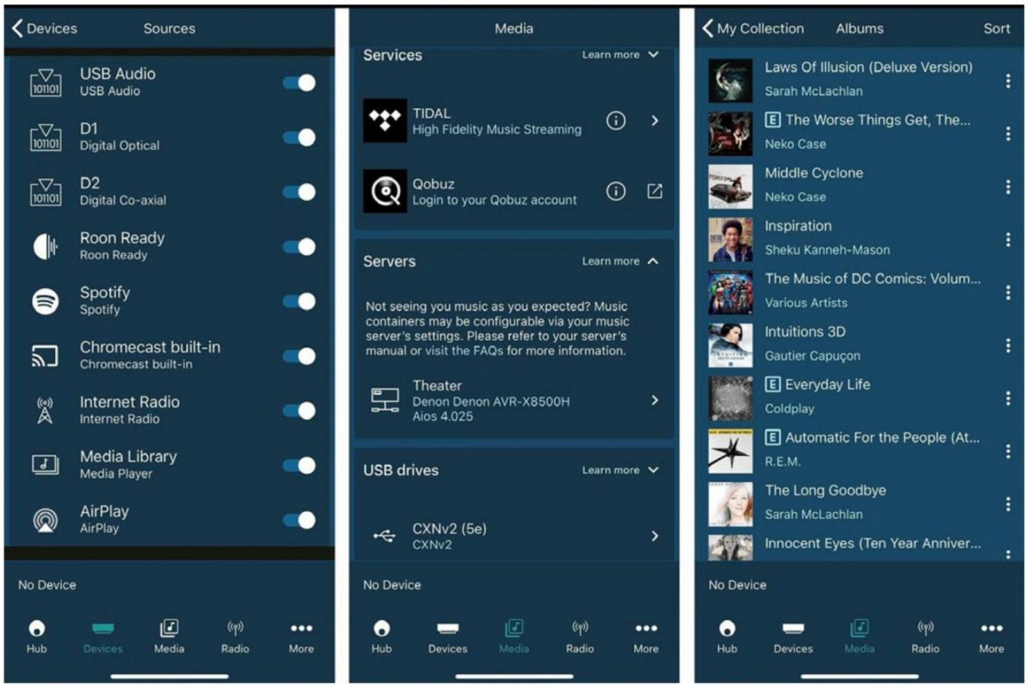
I use Roon religiously as my primary music server, and here's where Cambridge Audio's design brilliance paid off in spades. I could add the CXN (v2) as an "endpoint" for each supported protocol and create speaker groups accordingly. In other words, I could add the CXN (v2) as an AirPlay endpoint and Chromecast endpoint and create native AirPlay and Chromecast speaker groupings using the CXN (v2) in both. Moreover, I connected my Roon Nucleus server via USB to the CXN (v2) and connected it to my Anthem AVM 60 pre-amp. I therefore had the potential to create multiple, independent instances of the CXN (v2) to fit whatever protocol or architecture I craved. And for those of you who play DSD (Direct Stream Digital) sources, the CXN (v2) let me choose whether I wanted to use DoP (DSD over PCM) or PCM for digital output.

I could go on and on. I kicked the tires on the CXN (v2) for months mixing and matching review gear and my personal gear in and out, and the CXN (v2) never missed a beat and partied well with all of them.

THE STREAMMAGIC APP

While you can control Tidal and internet radio features directly from the CXN (v2)'s on-screen interface, you'll want to download Cambridge Audio's iOS or Android StreamMagic app to expand your experience—and the unit's functionality—

even further. The StreamMagic app acts as a command and control center for the CXN (v2) and other networked Cambridge Audio devices. StreamMagic gives you central command of Tidal and Quobuz integrations. I could seamlessly browse and play my Tidal music and playlists.


Devices
Sources
USB Audio
USB Audio
D1
Digital Optical
D2
Digital Co-axial
Roon Ready
Roon Ready
Spotify
Spotify
Chromecast built-in
Chromecast built-in
Internet Radio
Internet Radio
Media Library
Media Player
AirPlay
AirPlay
No Device
Hub
Devices
Media
Radio
More
Media
Services
Learn more
TIDAL
High Fidelity Music Streaming
Qobuz
Login to your Qobuz account
Servers
Learn more
Theater
Denon Denon AVR-X8500H
Aios 4.025
USB drives
Learn more
CXNv2 (5e)
CXNv2
No Device
Hub
Devices
Media
Radio
More
My Collection
Albums
Sort
Laws Of Illusion (Deluxe Version)
Sarah McLachlan
E The Worse Things Get, The...
Neko Case
Middle Cyclone
Neko Case
Inspiration
Sheku Kanneh-Mason
The Music of DC Comics: Volum...
Various Artists
Intuitions 3D
Gautier Capuçon
E Everyday Life
Coldplay
E Automatic For the People (At...
R.E.M.
The Long Goodbye
Sarah McLachlan
Innocent Eyes (Ten Year Anniver...
No Device
Hub
Devices
Media
Radio
More

Not seeing you music as you expected? Music containers may be configurable via your music server's settings. Please refer to your server's manual or visit the FAQs for more information.

Cambridge Audio's StreamMusic app for iOS and Andriod gives you full and flexible control over the CXN (v2)'s functions and settings.

The StreamMagic app made internet radio a truly worthwhile feature, too. I searched for radio stations in the U.S. and abroad. And by changing my iOS device's language keyboard, StreamMagic let me search for stations in Greece with their native Greek names. I searched for stations from Athens to Crete with ease. If you enjoy exploring foreign music stations, you can do so in your language of choice.

There were times, however, when I found the StreamMagic app to be a bit funky. On more than one occasion, the "settings" would simply spin endlessly, telling me that the connection was lost. Oddly enough, every other menu and function worked just fine. Cambridge needs to track down those Gremlins.

A HIGH-END REMOTE

I'd be remiss if I didn't give a nod to Cambridge Audio's outstanding IR remote control. I wish that the remote control had elements of the unit's brushed metal integrated. Nevertheless, the plastic remote feels solid and certainly high end. Buttons are well laid out—though those with visual difficulty will find the writing on the buttons to be a bit small. But every conceivable function is available at the press of a button, and once I learned where those functions were, I could call up basic functions without looking.

LISTENING TESTS

I set up the Cambridge Audio CXN (v2) into my main system with both analog audio output to my Anthem AVM 60 preamp and S/PDIF digital audio to the AVM 60. I set up the Anthem to support the analog and digital inputs separately. I connected it to my Roon Nucleus server by way of USB, Chromecast, and AirPlay 2. Benchmark AHB2 power amplifiers configured in bridged mono provided the power for Revel Ultima2 Salon speakers.

The best compliment I can pay the Cambridge Audio CXN (v2) is that I just set it and forgot it in my system. It just worked, time after time, letting me focus on the music and what I wanted to do. You'll find that the CXN (v2) will at times be brutally honest. If your source material isn't great, the CXN (v2) will let you know. On the flip side, well-recorded material shines with ample detail.

Comparing the CXN (v2)'s DAC to the Anthem AVM 60's DAC yielded easily audible differences. The Anthem uses an AKM AK4458 32-bit/768 kHz with differential output, where Cambridge Audio uses Wolfson WM8740 24-bit DACs. Sending a digital signal from the CXN (v2) to the Anthem, so that the Anthem could decode the bit stream, produced a warm, smooth, well-balanced, and velvety sound. Using the Cambridge Audio's analog outputs from the Wolfson WM8740's yielded a clean, detailed, but more relaxed sound, with a slightly deeper soundstage whose midrange in particular placed more emphasis on vocals.

BOTTOM LINE

I'm in love with Cambridge Audio's superlative CXN (v2). This network music streamer is sleek, smart, flexible, powerful, well thought out, and will fit into a variety of audio ecosystems. If you're a mixed audio marriage household juggling AirPlay, Chromecast, Tidal, Qobuz, Spotify, Roon, and other ecosystems, consider Cambridge Audio's CXN (v2) the definitive solution to lifelong bliss.

The unit's rich feature set and its solid sonics are well worth the lofty asking price of $1,099. For the diehard digital music devotee, Cambridge Audio's CXN (v2) audio streamer deserves an urgent audition, and it earns my highest recommendation at this price point. ■

Cambridge Audio CXN (v2)

PROS

- Extremely versatile, on its own or integrated with other high-end components.
- Supports every important music service, audio codec, and transport protocol.

CONS

- Remote control isn't as deluxe as the rest of the system.
- Bluetooth and Wi-Fi features cost extra.

PRICE

$1,099

COMPANY

Cambridge Audio

1More Dual Driver ANC Pro Wireless: This in-ear headphone has a split personality

You'll get clean, lean sound with ANC off, and rich, bass-heavy sound with ANC on.

BY SCOTT WILKINSON

I'm a big fan of 1More in-ear headphones (IEHs). The company's Stylish True Wireless (go.macworld.com/stwr) is my go-to IEH for the gym and walks around the neighborhood, and I gave the Triple Driver IEH a rating of 5—the only such rating I've given to date—in my review of three wired models (go.macworld.com/3wrd) from 1More.

So, it should come as no surprise that I was excited to review 1More's latest offering, the Dual Driver ANC Pro wireless IEH. Its form

IMAGE: 1MORE

factor is similar to several of the company's models but different than the other wireless IEHs I've tried. I really like the form factor, but sound quality is most important, and the Dual Driver ANC Pro is something of a split personality in that regard.

FEATURES

The Dual Driver ANC Pro consists of a flexible, silicone-covered neckband with thin wires emerging from both ends that connect to the earpieces. The back of the earpieces are magnetic, so they clasp together to form a necklace for convenient, safe storage when not in use. This is much better than putting tiny earpieces in your pocket or fiddling with a carrying case, especially if you use large eartips as I do.

I like this form factor a lot. It allows the controls to be placed on the neckband, where they can be larger, more separated, and more intuitive than controls on true wireless IEHs. Also, the Dual Driver ANC Pro carries an IPX5 rating for water resistance, so you can work up a real sweat without worrying about any damage that might cause.

As its name implies, this IEH uses two drivers in each earpiece: a 13.6 mm dynamic driver with titanium-composite diaphragm for the low and mid frequencies and a balanced armature for the highs. The resulting frequency response extends from 20Hz to 40kHz (no tolerance given), which means it can render high-res audio.

The 1More Dual Driver ANC Pro Wireless' ear tips are tethered to a silicone neckband.

Also in the name is the term ANC, which stands for active noise cancellation. This IEH offers what 1More calls "hybrid noise cancellation" with two microphones in each earpiece. One is called a feedforward mic, which picks up environmental noise, and the other is called a feedback mic, which fine tunes the ANC adjustments from the feedforward mic, forming a processing loop. In addition, you can select between two levels of ANC; Level 1 provides up to 35dB of attenuation, while Level 2 provides 20- to 25dB. Of course, you can also turn off ANC entirely.

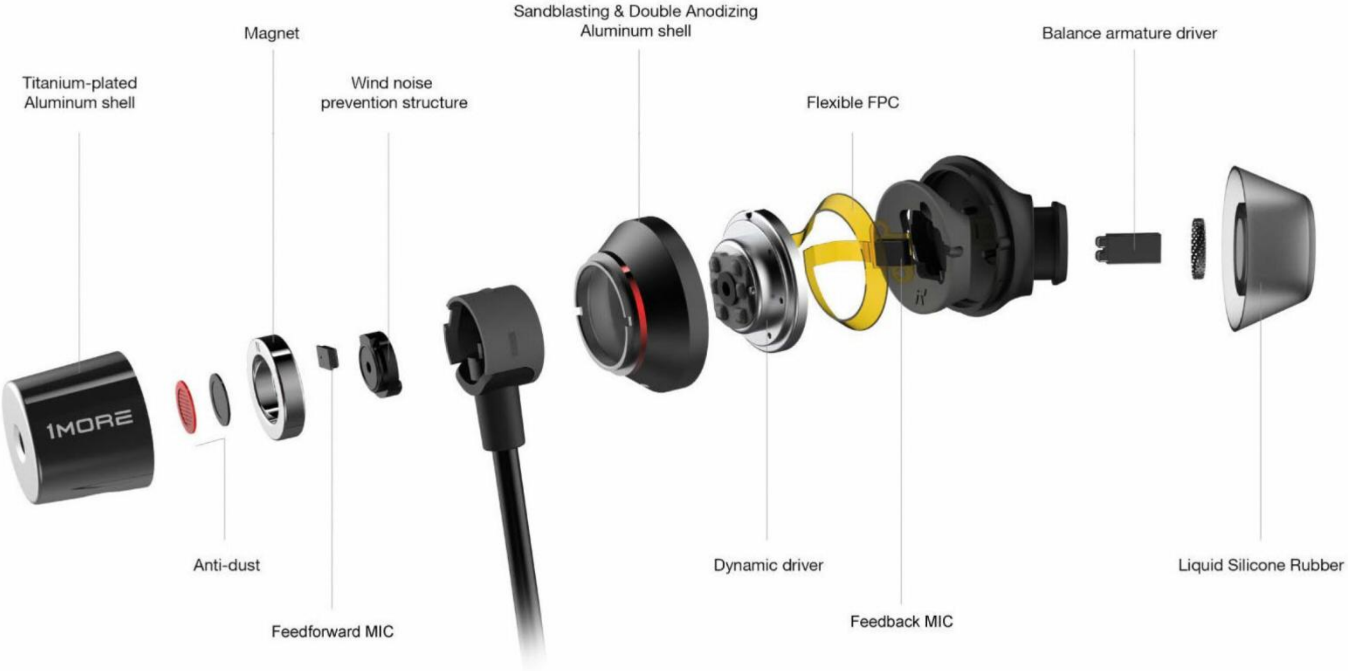
Another aspect of the ANC feature is wind noise reduction, which you can enable separately when ANC is on. According to the webpage for this product, it "suppresses the microphonics caused by wind when ANC is on."

A separate mic in the neckband picks up your voice during phone calls. The company calls this mic ENC (environmental noise cancelling), which, combined with a DNN (deep neural network) algorithm, is said to filter out ambient noise for clear phone calls, even in loud settings.

The Dual Driver ANC Pro implements Bluetooth 5, which provides faster transmission over longer distances compared with Bluetooth 4.2. It supports Sony's LDAC codec for Android and AAC (Advanced Audio Coding) for Apple products. Both are lossy but higher quality than most Bluetooth codecs; in particular, LDAC boasts a data rate of 990Kbps compared with 328Kbps for SBC, which is also supported. On the other hand, this IEH does not support aptX.

In addition to Bluetooth, you can connect the Dual Driver ANC Pro to a USB source device, such as a computer, using the USB-C port at the end of the left side of the neckband and listen to lossless audio. Interestingly, the product page includes this caveat: "Headphone must have charge in order to be listened via a wired connection." Okay, but the same USB-C port is used to charge the battery, so unless the USB source device does not provide power, making this connection will charge the battery, fulfilling that condition by default.

Speaking of the battery, it's a 160mAh


Titanium-plated Aluminum shell
Magnet
Wind noise prevention structure
Sandblasting & Double Anodizing Aluminum shell
Flexible FPC
Balance armature driver
1MORE
Anti-dust
Feedforward MIC
Dynamic driver
Feedback MIC
Liquid Silicone Rubber

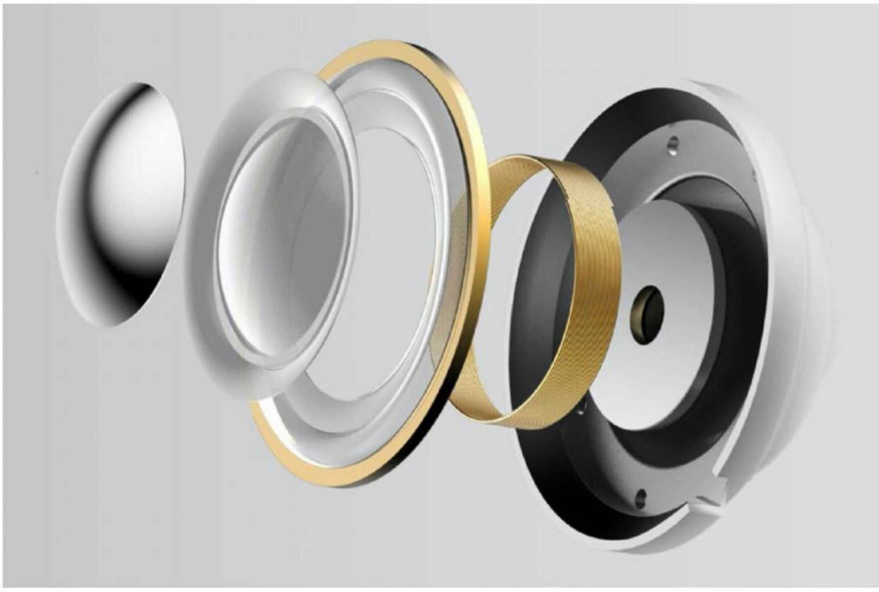
Each earpiece includes many components, including a dynamic driver, balanced-armature driver, and two microphones.

on/off, and ANC 1/2/off.

On the inside surface are the volume up and down buttons on either end of a rocker switch as well as the play/pause button, which also skips to the next or previous track by pressing it twice or three times respectively. This button also lets you answer, hang up, and decline a phone call, and you can activate your device's voice control (such as Siri and Google Assistant) by holding the button, but only when there is no music playing or a phone call in progress.

Changing the power, ANC, and wind noise-reduction settings provides an audible cue that indicates when they are switched on or off and which ANC mode is selected. The cues are short, distinctive sound effects, which is okay, though I would prefer voice prompts stating the current condition and battery level as some headphones, including many 1More models, provide.

The company also offers a free app called 1More Music for iOS and Android devices. The app is simple and straightforward, allowing you to enable or disable ANC and wind noise reduction. It also offers a quick guide to the product and a battery-level indicator.

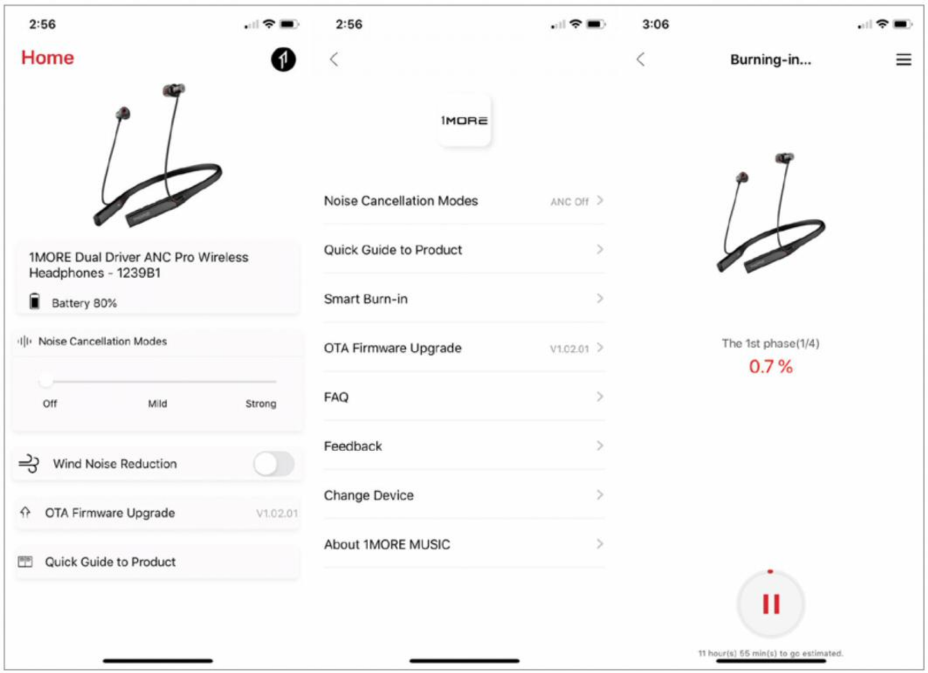


The 13.6 mm dynamic driver is based on a titanium-composite diaphragm consisting of titanium and PET layers.

lithium-ion type that's good for up to 20 hours of music (AAC format, ANC off, 50 percent volume) on a full charge, which takes about one hour to complete from an empty state. Even better, a quick 10-minute charge provides up to three hours of play time. Interestingly, files in the LDAC format gobble battery power much more quickly, lasting only about eight hours at 50 percent volume with ANC off. Turning ANC on cuts three to four hours from the total play time—except for LDAC, which only loses about half an hour.

USER INTERFACE

As I mentioned earlier, the controls are located on the neckband—specifically, on the left side. On the top, there are three buttons: power on/off, wind noise reduction


2:56
Home
1MORE Dual Driver ANC Pro Wireless Headphones - 1239B1
Battery 80%
Noise Cancellation Modes
Off
Mild
Strong
Wind Noise Reduction
OTA Firmware Upgrade
V1.02.01
Quick Guide to Product
2:56
1MORE
Noise Cancellation Modes
ANC Off
Quick Guide to Product
Smart Burn-in
OTA Firmware Upgrade
V1.02.01
FAQ
Feedback
Change Device
About 1MORE MUSIC
3:06
Burning-in...
The 1st phase(1/4)
0.7 %
11 hour(s) 55 min(s) to go estimated.

The 1More Music app provides complete control for the Dual Driver ANC Pro (as well as other 1More models), including ANC modes, wind noise reduction, and firmware updates. Also on the home screen (left) is a battery-level indicator and a link to a quick guide. The secondary screen (center) offers access to some of the same controls as well as additional info and the Smart Burn-In feature, which plays noise signals over a total of 12 hours (right).

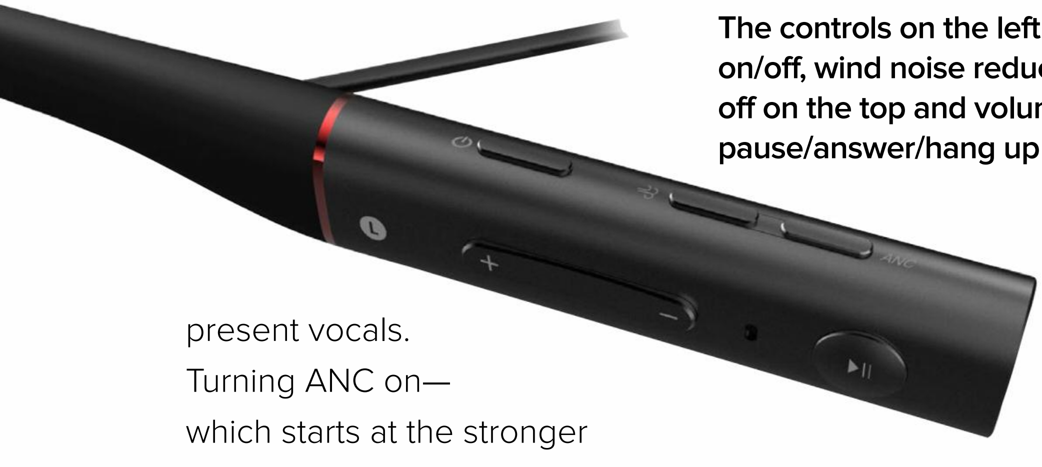
Another feature in the app is called Smart Burn-In, which plays noise signals for a total of 12 hours to break in the drivers. I don't place much stock in the notion that breaking in drivers makes a big difference in sound quality, so I didn't do it in this case. But it's there if you feel differently. In addition, the app reveals the firmware version and lets you update it if necessary. My review sample had version 1.01.05, while the current version is 1.02.01, so I updated it.

PERFORMANCE

For the best performance from any IEH, it's critical to select the right eartips for your particular ears. The eartips should completely seal your ear canals; if they're too small, environmental sounds get through, the overall sound quality is thin and fizzy, and the bass is anemic.

The Dual Driver ANC Pro comes with four pairs of silicone eartips: 11mm, 13mm, 14.2mm (pre-installed), and 15.5mm. All have an oval cross section, which is intended to help them achieve a good seal in the oval opening to the ear canal. The nozzles on which the eartips are installed are also oval, assuring that the tips are in the correct orientation. It's a tight fit and a bit tricky to change out the eartips. I normally use 1More's circular 14.5mm silicone eartips on all IEHs, but I tried the 14.2mm tips that come with the Dual Driver ANC Pro, and they worked fine for me.

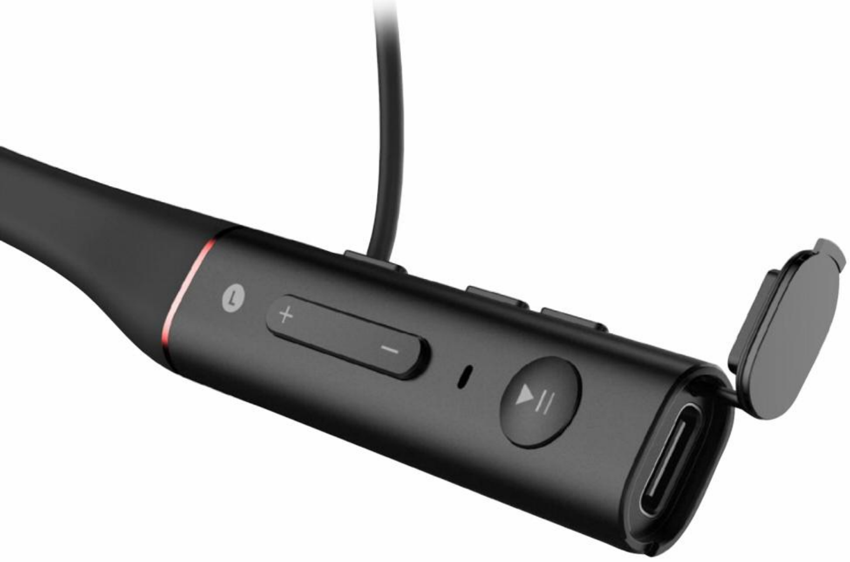
As usual, I turned to Tidal's Master library from my iPhone XS as the source for test tracks. First up was "Flame Twin" from Norah Jones' new album *Pick Me Up Off the Floor*. With ANC off, the sound was clean and well balanced with clear and



The controls on the left neckband include power on/off, wind noise reduction on/off, and ANC 1/2/off on the top and volume up/down and play/pause/answer/hang up phone calls on the side.

present vocals. Turning ANC on—which starts at the stronger setting—the level increased substantially, and the sound became much richer with elevated bass that was a bit overbalanced. The milder ANC setting sounded about the same.

I had never heard the electronica of Apparat before, but "Hosea" from *Soundtraks: Dämonen* is a wonderful kaleidoscope of timbres swirling around the stereo soundfield. With ANC off, the sound was clean but a tad thin and anemic. I preferred the richer, deeper sound with ANC on in this case. Again, there wasn't much difference between ANC Level 1 and 2.



The USB-C port at the end of the left neckband connects to a charger, and it can also be connected to a USB port on a computer to play audio without Bluetooth.

Another new discovery—this time in jazz—was bassist and composer Misha Mullov-Abbado. I listened to "Seven Colours" from his album *Dream Circus*, which includes piano, acoustic bass, and drums along with trumpet, alto sax, and tenor sax playing some beautifully inventive melodic and harmonic ideas. With ANC off, the sound was clean, lean, and tight; turning it on caused the sound to become much richer and fuller, and the bass was a bit overbalanced and indistinct.

Turning to country, I checked out "Maggie" from Sarah Jarosz' album *World on the Ground*. She has an exquisite voice, and the recording quality is exceptional. With ANC off, the sound was clean and well-balanced. Turning ANC on, the track became louder and richer with more bass—perhaps a bit too much.

Moving into more familiar territory, I listened to the first movement of Beethoven's Piano Sonata No. 8, Op. 13

The 1More Dual Driver ANC Pro Wireless are among the best-performing smartphone companions we've tested.

“Pathétique” as performed by Wilhelm Backhaus on the aptly named album *Beethoven Sonatas*. This time, with ANC off, the piano sounded thin and even a bit strident. Turning ANC on, the track was louder and fuller, which I strongly preferred.

For a few more instruments, I cued up the first movement of Wind Quintet, Op. 79 by August Klughardt as performed by Les Vents Français on their album *Romantique*. With ANC off, the sound was clean and a bit thin, and each instrument was clearly delineated. Turning ANC on, the track became louder and richer, and I could still make out each instrument quite easily.

For some big guns, I listened to the third movement of John Adams' *Must the Devil Have All the Good Tunes?* as performed by the Los Angeles Philharmonic under Gustavo Dudamel with Yuja Wang playing the featured piano part. Once again, with ANC off, the sound was clean and clear with somewhat lean bass and excellent delineation of individual instruments and sections. The track got louder and fuller with ANC on, and the bass became a bit overbalanced.

To test the phone-headset performance, I had my wife call me. It worked better in this respect than any other IEH I've tried; her voice sounded warm and clean, and she reported that my voice sounded excellent as well.

Finally, I took the Dual Driver ANC Pro out to the garage and ran the clothes dryer to test its noise cancellation. The stronger Level 1 setting certainly reduced the low-frequency rumble, but it was less effective than other ANC headphones I've tried. The milder Level 2 setting let a bit more noise through, but the difference wasn't pronounced.

COMPARISON TO 1MORE STYLISH, SONY WH-1000XM3

The only other true wireless IEH I had on hand during this review was the 1More Stylish, which I reviewed here (go.

macworld.com/1mst), so I listened to each track with them as well as the Dual Driver ANC Pro. In every case, the Stylish sounded much like the Dual Driver ANC Pro with its ANC off—clean, clear, and well-balanced most of the time. Overall, the Stylish had slightly less depth, though in some cases, such as "Seven Colours" and "Maggie," the bass was a bit more present.

My wife and I compared the sound of the Stylish and Dual Driver ANC Pro on a phone call and found that the Stylish sounded much worse—thin and electronic at both ends. By contrast, the new model sounded clear and natural.

During my noise-cancellation test, I compared the Dual Driver ANC Pro with the Sony WH-1000XM3, reviewed here (go.macworld.com/whxm), which is the best ANC headphone I've tried. The Sony provided far more noise reduction, which is to be expected with an over-ear headphone. Even with a good seal in the ear canal, it's extremely difficult for an IEH to block as much sound.

½

1More Dual Driver ANC Pro Wireless

PROS
- Clean, lean sound with ANC off.
- Rich, sumptuous sound with ANC on.
- Superb phone-headset sound.

CONS
- Sound is sometimes a bit thin with ANC off.
- Bass is sometimes overbalanced with ANC on.
- ANC is only moderately effective.

PRICE
$149

COMPANY
1More

BOTTOM LINE

The 1More Dual Driver ANC Pro has a split personality. With ANC off, its sound is clean and lean—even a bit thin on some tracks—but when you turn ANC on, the sound becomes rich and sumptuous with bass that is sometimes overbalanced. Either way, the sound is not bad by any means—no distortion, no congestion, no veiling. I'm going to assume that most people will want to use this IEM with ANC on, so if you're a basshead, you'll love it in that mode.

But if you favor a leaner, less bass-heavy balance, you might find it a bit much. In that case, you can turn ANC off, which isn't all that effective anyway. It does reduce ambient noise somewhat, but not nearly as much as some over-ear headphones I've tried. On the plus side, its sound as a phone headset is excellent, and I really like the neckband form factor with its well-spaced controls and attached earpieces that can't get lost.

Is the 1More Dual Driver ANC Pro Wireless worth $150? If you don't care about ANC, the answer is yes—you can turn ANC off for a leaner sound or on for a richer, bass-heavy sound according to your preference. On the other hand, if you want ANC with a clean and lean sound or no ANC with lots of bass, then no. It's entirely up to you. ■

Atlantic Technology FS-HR280: Reasonable, but not outstanding sound quality for the price

Vocals sound great, and the comfort level is high, but the overall sound from these cans is slightly veiled.

BY SCOTT WILKINSON

Atlantic Technology has long been known for excellent value in home-theater speakers. This year, the company has applied its considerable transducer expertise to headphones, introducing two over-ear models and one in-ear offering.

The flagship FS-HR280 is designed for audiophiles. It has no wireless Bluetooth or active noise-cancellation functionality. Instead, you simply plug it into the source and listen to the best sound quality that

IMAGE: 1MORE

Atlantic Technology knows how to wring from headphones. These are reasonably good headphones, but there's room for improvement.

FEATURES

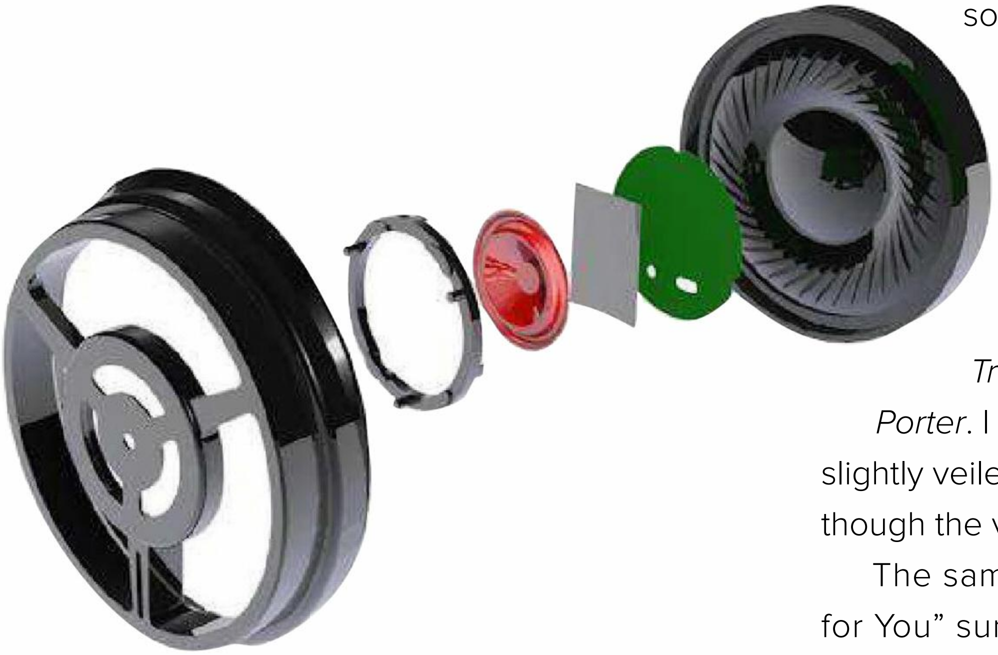
The FS-HR280 is a closed-back, over-ear headphone with super-soft, leather-clad earpads and headband. The earcups pivot to accommodate various head shapes and sizes, providing a good noise-isolation seal, and they fold flat for storage in the included hard carrying case.

The earcups pivot to fold flat for storage in the included hard case.

I like the simple, elegant design, though the earcups and pivoting yokes are made of plastic, which feels a bit cheap. On the plus side, I'm sure it's a lot lighter than metal would be. Speaking of which, the FS-HR280 weighs in at only 10.3 ounces.

Unlike many over-ear headphones, the FS-HR280 utilizes two drivers in each earcup: a 40mm thin-film dynamic bass driver with neodymium magnet, and a 20mm, rectangular, patented ceramic tweeter. This so-called Quad-Driver system is specified to deliver a frequency response from 20Hz to 40kHz (no tolerance given) with THD less than 0.5% (1kHz, 105dB). The nominal impedance is rated at 32 ohms (±15%) with a sensitivity of 105dB (1kHz/1Vrms) and a power-handling capability of 10-30mW, making this headphone easy to drive from just about any device.

The detachable 4-foot cable connects to the left earcup and includes oxygen-free copper conductors within a braided-nylon sheath that resists tangling. The 3.5mm gold-plated plugs on both ends have knurled no-slip aluminum housings with integrated strain relief. Conveniently, the cable also provides an in-line microphone with smartphone controls for answering and hanging up calls, playing and pausing music, adjusting the volume, and skipping tracks.



Each earcup utilizes two drivers: a 40mm thin-film dynamic woofer (black) and a 20mm rectangular ceramic tweeter (gray).

PERFORMANCE

Before I did my formal listening, I used the FS-HR280 to monitor some simple recordings that I was working on with my wife, singer/songwriter Joanna Cazden, in preparation for a "virtual" Passover seder via Zoom, which was necessitated by the novel coronavirus pandemic. She commented about how good the sound was on the headphones, and I had to agree.

For my formal evaluation, I listened to the FS-HR280 using my iPhone XS playing tracks from Tidal's Master high-res audio library. I also used the iFi hip-dac portable DAC/headphone amp (go.macworld.com/ihip) I reviewed earlier, for its superior sound quality compared with the iPhone's internal DAC/amp.

Starting with some jazz, I cued up "I Concentrate on You" as sung by Harry Connick Jr. with big band and strings from his album *True Love: A Celebration of Cole Porter*. I was immediately struck by a slightly veiled sound with indistinct bass, though the voice was clear and forward.

The same was true with "Since I Fell for You" sung by Al Jarreau on the album *Double Vision* by Bob James and David Sanborn. In this case, the bass was a bit bloated, though the vocal was nice and clear.

Moving on to classical, I listened to the third movement of Beethoven's Symphony No. 7 as performed by the West-Eastern Divan Orchestra under Daniel Barenboim on the album *Beethoven Symphony No.7/ Triple Concerto*. The sound was a bit congested and thick with slightly bloated bass, though the delineation of instrumental sections was pretty good.

I also listened to some solo piano—specifically, Scriabin's Piano Sonata No. 10, Op. 70 as performed by Yuja Wang live at Philharmonic Hall in Berlin on the album *The Berlin Recital*. As I had come to expect, the piano sounded slightly congested, especially in the low end.

Turning to pop, I listened to "Ruby

Baby" by one of my favorite artists, Donald Fagen, on his album *The Nightfly*. Overall, the sound was a bit clouded, as if covered in a thin fog, though again, the vocals were quite clear. Likewise with "Love Shack" from the B-52s' album *Cosmic Thing (30th Anniversary Edition)*—it sounded somewhat veiled with slightly bloated bass and good vocals.

Finally, I tried "Paper Tiger" from Beck's album *Sea Change*. This track has a lot of low bass, which was a bit bloated, and the strings were quite thick. On this track, the vocals are mixed way forward, and they sounded quite good.

COMPARISON WITH SONY WH-1000XM3 AND PSB M4U 8

I had two other headphones on hand in the same price range as the FS-HR280: the $299 Sony WH-1000XM3 (go.macworld.com/snwh), which TechHive Video Director Adam, Patrick Murray reviewed, and the $399 PSB M4U 8 (go.macworld.com/pm4u) I reviewed for TechHive. Both are Bluetooth models with active noise cancellation, but they can also serve as passive wired headphones without turning their power on. In addition to the FS-HR280, I listened to each track with both of these headphones in wired, passive, unpowered mode.

The WH-1000XM3 sounded leaner and clearer in every case. However, its bass was always somewhat deficient. By contrast, the M4U 8 had better bass that was well balanced with the rest of the sonic spectrum, and the overall sound was clearer than the FS-HR280. I ended up preferring its sound over the other two.

I found that a bit surprising; in my review of the M4U 8, I had written, "Using the cable with the power off, the sound was more veiled and the bass was less well defined." But that was listening to high-bitrate MP3s from an iPhone 6 with its onboard DAC/amp. Now, I'm listening to high-res audio from Tidal on an iPhone XS with the iFi hip-dac—a significantly better audio setup.

The FS-HR280 is fairly lightweight and very comfortable to wear for extended periods.

BOTTOM LINE

The Atlantic Technology FS-HR280 is a study in contrasts. Vocals sounded uniformly excellent—which is undoubtedly why my wife and I had a very good initial impression—and the delineation of instruments was quite good in general. Plus, it's very comfortable to wear for extended periods. The overall sound, however, was always a bit veiled and often slightly congested, and the bass was slightly indistinct and a tad bloated in many cases.

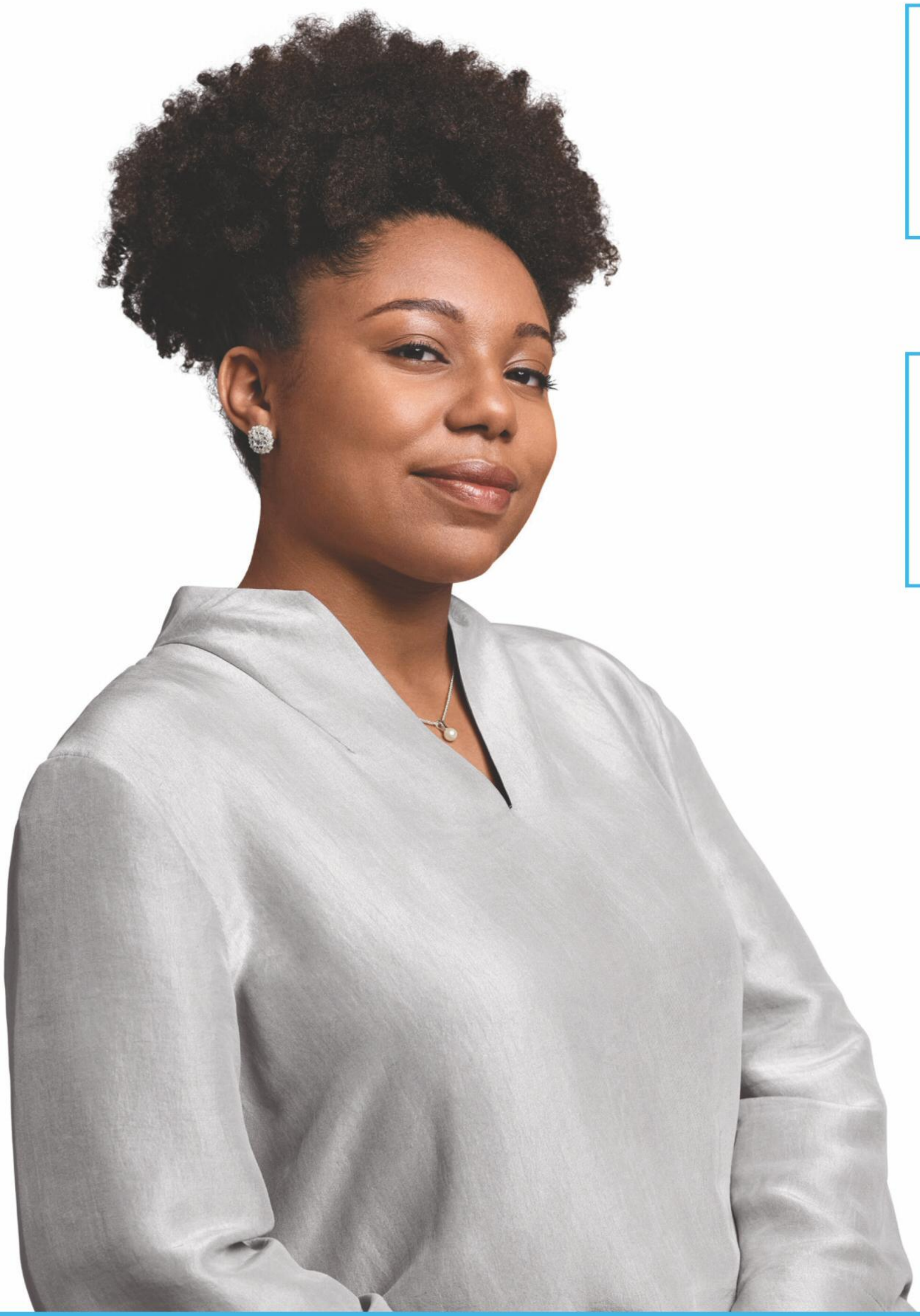
That isn't to say the sound was bad, just not quite as good as I've heard from other headphones, especially in this price range. And thanks to my experience reviewing many headphones over the last couple of years, I immediately noticed the slightly veiled, congested sound when listening to commercial tracks. It became all the more obvious in direct comparison with the Sony WH-1000XM3 and PSB M4U 8.

If you're shopping for a pair of high-quality, over-ear headphones in the $300 price range, the FS-HR280 is certainly a decent choice. The Sony WH-1000XM3 is the same price, and it offers Bluetooth and superb active noise cancelling (ANC) as well, though its wired, passive performance was noticeably bass-deficient. The PSB M4U 8 is $100 more, and its Bluetooth and wired, passive performance are both exceptional—at least with a high-quality source—though the sound quality with ANC on is not quite as good.

Which is best for you? That depends on your specific needs and preferences. If you don't need Bluetooth or ANC, the FS-HR280 is reasonably good, especially for a venerable home-theater speaker company's first foray into headphones. But it ain't cheap, either. I suspect there are better options in this price range. ■

Atlantic
TECHNOLOGY
FS-HR280
Atlantic

The packaging is quite a bit larger than the headphones to accommodate the hard case.



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Diagnosed with autism

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BY GLENN FLEISHMAN

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HOW TO MAKE SURE THE PLAY/PAUSE BUTTON WORKS ON YOUR MAC

At one point in macOS history, if you had a Play/Pause button on your keyboard, it kept "focus" on whatever the last music app you used was. Then Apple broadened that to include anything with a music player. You could be in iTunes and use the keyboard to pause playback, then switch to YouTube in a browser, press play, and the keyboard would help you play and pause there, too.

Or at least most of the time. In my experience and that of many people who post about it, the last music player isn't always tracked well. That's especially the case if you close a window in a browser that had a video or audio player in it, and then press the Play/Pause button.

The problem predates Mojave, and Catalina doesn't improve on it. But if you regularly use iTunes or Spotify or switch between them, a simple and free utility will at least let you lock play/pause focus to one or both of those apps.

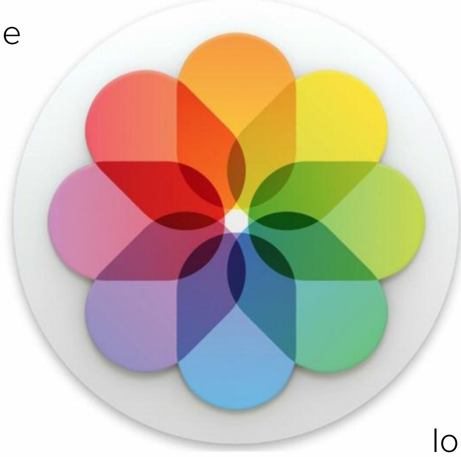
IMAGE: APPLE

Mac Media Key Forwarder 3.1 works with Catalina, and creates a simple menu that you can select behavior from, such as choosing iTunes instead of Spotify or vice versa. The app will no longer be developed, but the 3.1 version works and is downloadable from this file-transfer site (go.macworld.com/fltr) operated by its developer.

For a somewhat more complicated but more exhaustive media-playback-focus controller across both audio and video, try BeardedSpice (go.macworld.com/bspi), which is also free.

HOW TO TAKE PHOTOS OF PARTICULAR PEOPLE OUT OF YOUR PHOTOS LIBRARY

Let's face it: sometimes you may need to cut someone out of your life—not just in the walking-around world, but in the digital one. Because of the efficiency and ability to collect and store images and videos indefinitely, you can have constant unwanted visual reminders of an ex or exes pervading your media library, or of family members and friends who are no longer in your life. If you've lost someone dear, you may also want to remove their images from your Photos library and retain them elsewhere.



This is certainly in part because of Apple's (and other companies') desire to help us relive wonderful moments from our past, which can include celebrating past birthdays of people now dead (go.macworld.com/nwde)or inviting us to enjoy memories with people from whom we are now sundered.

Photos makes it relatively easy to excise people from our life with one important proviso: you had to tag the photos by hand or use Photos face-identifying option to pull them up there.

To be sure, these options also let you find collections of photos you can add to an album, making it easier to find pictures of someone in the future. You can also export the contents of that album and then remove the images from your Photos library if you want to retain pictures of that person's visage offline.

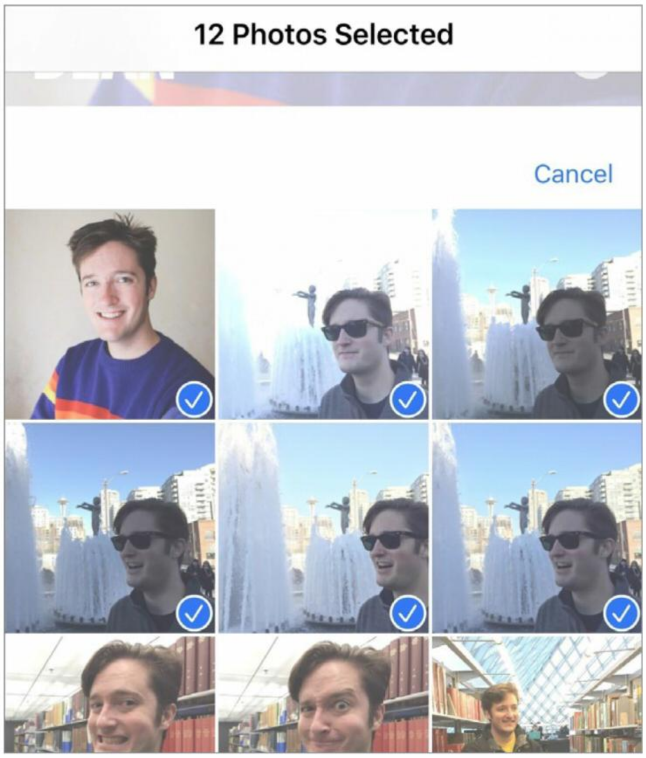
To use the People album in macOS, follow these steps:

1. In Photos, click the People album.

2. Double-click the album for that person.

3. Review any images that Photos wants you to look at, if that prompt appears at the top, in the interests of having better matches.

4. Click Show More. That label is at the top of the view if there's no slideshow, and



Dean is a good friend, but for the purposes of demonstration, he's got to go!

below if it there is one.

5. Choose Edit → Select All (Command-A) and then choose Image → Delete X Images (or press the Delete key).

6. Confirm image deletion and they're removed.

(To save to an album, Control-click and select Add To → New Album or an existing album.)

To use the People album iOS and iPadOS, follow these steps:

1. In Photos, tap the Albums button at the bottom of the screen.

2. Tap the person you want to remove.

3. ap Show More.

4. Tap Select.

5. You can tap individual images or press and drag to select many images at once.

6. Tap the trash can icon.

7. Confirm deletion and they're removed.

(To save to an album, tap the Share button and then swipe up until you can see and tap Add to Album. You can then select a new album or an existing one.)

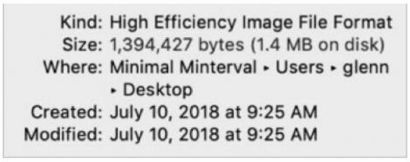
You can also search against a partial or full name, which sweeps in both identified entries in the People album and any images or movies you have tagged in the title, keywords, or description.

Photos' search feature remains slow and poor even after years of development, so you may see a variety of results tagged with the same person or name with note beneath the total matched of "title," "filename," and so forth. There's no way to simply select all of those, so you have to search, select, and repeat in turn.

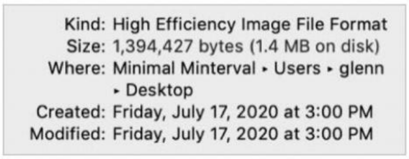
Whichever item you select from search results, you can select photos and videos individually or use Select All in macOS or Select in iOS and iPadOS plus press and drag. You can then delete or add to an album as you wish.

HOW TO AUTOMATE CHANGING THE DATE AND TIME ON HEIC FILES

When you snap a picture with a smartphone, tablet, or camera, the date and time are encoded in the image's EXIF



Kind: High Efficiency Image File Format
Size: 1,394,427 bytes (1.4 MB on disk)
Where: Minimal Minterval ▸ Users ▸ glenn ▸ Desktop
Created: July 10, 2018 at 9:25 AM
Modified: July 10, 2018 at 9:25 AM



Kind: High Efficiency Image File Format
Size: 1,394,427 bytes (1.4 MB on disk)
Where: Minimal Minterval ▸ Users ▸ glenn ▸ Desktop
Created: Friday, July 17, 2020 at 3:00 PM
Modified: Friday, July 17, 2020 at 3:00 PM

Photos for Mojave exports this image with the correct Finder creation and modification date (top, above), but Catalina uses the export date and time (above).

(Exchangeable image file format) metadata. It's embedded so that it can be used later by any software that works with the image.

However, as readers will testify, it's very easy to wind up with a mismatch between the time and date recorded in an image and what they see for creation date in the Finder on a Mac. Photos for macOS seems to have made this worse in Catalina. Export an image from Photos in Mojave or earlier versions of macOS using File → Export → Export Unmodified Original, and Photos uses the same timestamp you can view via Window → Info.

For example, this picture I took at Shakespeare's Globe in London on July 10, 2018 exports correctly with that creation and modified date from my Mac running Mojave. On my Catalina Mac, the same file linked to the same iCloud Photos collection shows up with a Finder created and modified timestamp of right now.

While Photos includes an option to adjust the timestamp on single photos and videos or shift it for batches, that doesn't help in this situation, where the items are inside the Photos Library and you want to have them sort correctly and be searchable by date correctly in the Finder.

A Better Finder Attributes ($17.95 from go.macworld.com/bter) is what I've recommended previously, as it can extract the EXIF timestamp and update the Finder attributes, including for batches of files.

That's fine if you're using JPEG, CR2, NEF, ARF, RAF, SR2, CRW, PEF, and CIFF image formats, all of which the app can manage. But it doesn't support HEIC, Apple's implementation of an industry-standard high-efficiency compression format introduced a few years ago to preserve and video quality while packing in image data more tightly.

If you've switched to HEIC, as many people have, GraphicConverter ($39.95 from go.macworld.com/gcnv) is the best option. An image editor and Swiss Army knife for image formats that's been in active development for 28 years (go.macworld.com/28yr), it also offers two kinds of batch operations:

> Using File ➡ Browse, you can navigate to a folder of images, select some or all, and then Control-click to select Exif Metadata ➡ Set Creation and Modification Date Depending on Exif. This updates the Finder timestamps. (It also offers other options).

> You can also use GraphicConverter's powerful batch-processing feature that lets you stack up operations via Convert & Modify. This feature requires careful study of the manual, but let you create a standard task you can then apply to selected folders, including subfolders. Once mastered, it gives you access to powerful multi-step photo-processing in general, so it's worth learning if you have potential future needs.

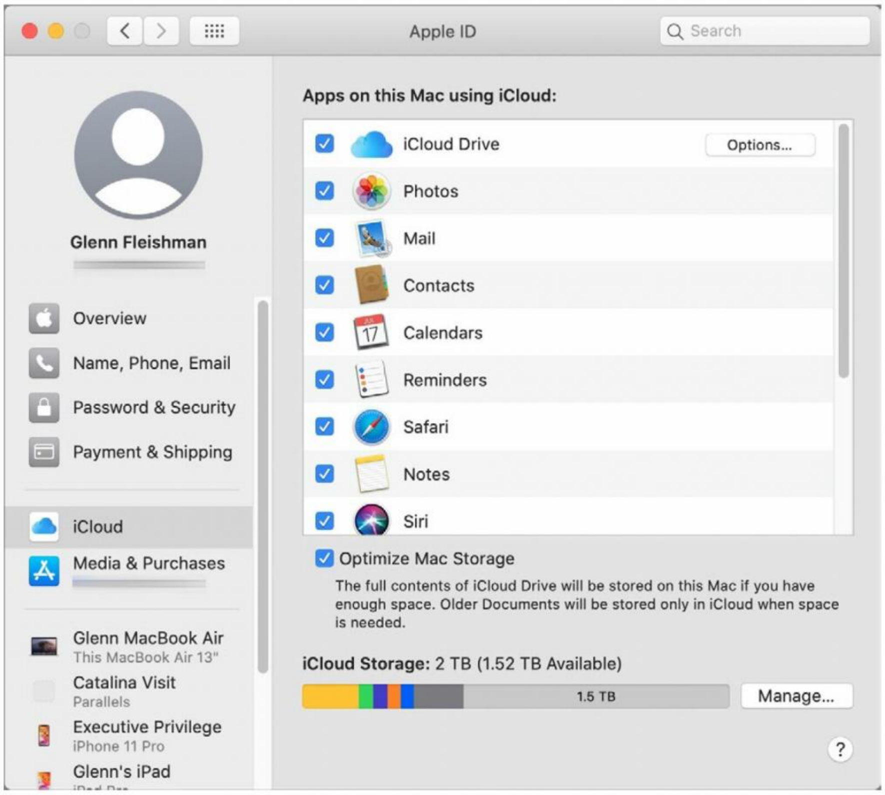
If you just need to make this sort of change in bulk once, both A Better Finder Attributes and GraphicConvert offer free trials. But I find myself reaching for both utilities again and again.

HOW TO USE iCLOUD TO COPE WITH A MAC THAT'S LOW ON STORAGE

Because of the relatively high cost of SSD storage, when buying a new Mac you might choose to pick a smaller-capacity drive than in a Mac you're replacing. That might be to reduce the overall expense or to spend your budget on more RAM or a faster processor. Apple still offers laptops with 256GB SSDs, and that seems a little snug if you have digital downloads or ripped music and take even a modest amount of photos and videos.

iCloud is a solution for offloading on-device storage and offers a kind of loose backup of that material, too. In the US, you can upgrade iCloud storage (go.macworld.com/upcl) from the included 5GB to 200GB for $2.99 per month and 2TB for $9.99 per month.

Here's a strategy for migration, if you're comfortable with many of your files having


Apple ID
Search
Glenn Fleishman
Overview
Name, Phone, Email
Password & Security
Payment & Shipping
iCloud
Media & Purchases
Glenn MacBook Air
This MacBook Air 13"
Catalina Visit
Parallels
Executive Privilege
iPhone 11 Pro
Glenn's iPad
Options...
Manage...
1.5 TB
?

Apps on this Mac using iCloud:

- ☑ iCloud Drive
- ☑ Photos
- ☑ Mail
- ☑ Contacts
- ☑ Calendars
- ☑ Reminders
- ☑ Safari
- ☑ Notes
- ☑ Siri

☑ Optimize Mac Storage

The full contents of iCloud Drive will be stored on this Mac if you have enough space. Older Documents will be stored only in iCloud when space is needed.

iCloud Storage: 2 TB (1.52 TB Available)

Check Optimize Mac Storage to have macOS automatically remove local copies of files.

the only copy living in iCloud.

Enable iCloud Photos in Photos

In Photos, choose Photos → Preferences → iCloud. Check the iCloud Photos box and then select Optimize Mac Storage. If iCloud Photos was already enabled, macOS will only for sure retain thumbnails of images and videos. However, if you're turning it on for the first time, Photos will upload all locally stored images. After those are copied to iCloud storage, Photos can optionally delete any local version and just show a thumbnail.

For a large Photos library, this can restore nearly all the space occupied by the library. Photos and videos are downloaded on demand as you view or use them.

Optimize iCloud Drive storage

In the Apple ID preference pane's iCloud view (Catalina) or the iCloud preference pane (Mojave and earlier), there's a checkbox marked Optimized Mac Storage. If it's selected, macOS removes the least-accessed files from your local synced copy of iCloud Drive as your computer's available storage drops; these files remain available in your online iCloud storage.

A sort of shadow version remains available on your desktop, so you can see the file and search against it. If you try to open that file, macOS quietly retrieves it from your iCloud account to make it available.

Enable Desktop & Documents Folders in iCloud Drive

Outside of images, your videos, and locally stored music, your Documents folder can occupy the most space. Some people organize on their Desktop, making it necessary to link both. With this item checked in iCloud Drive's Options, macOS syncs the contents with iCloud Drive. But with the Optimized Mac Storage box checked as well, your Desktop and Documents folders are removed as necessary to make room on local storage after being uploaded.

iCloud Music Library via Apple Music or iTunes Match

With a subscription to the Apple Music service (various prices) or iTunes Match ($24.99 per year from go.macworld.com/imtc), you can use iCloud Music Library (go.macworld.com/icms) to sync music files you have downloaded on your Mac to iCloud. This doesn't count against your iCloud storage, interestingly enough. Locally downloaded music and audio might include songs you ripped from CDs you own, purchases from Bandcamp and directly from musicians, songs and audio you've recorded yourself, and DRM-free iTunes Store items.

However, Apple Music and iTunes Match will replace any song that matches against a song found in the iTunes Store with a 256Kbps AAC file. That may not be desirable, and the matches aren't always perfect. Apple improved on matching quite a bit a few years ago, but if you have any personal or non-label music, read up on Macworld and other sites about problems you might still encounter before proceeding. If you've only purchased iTunes Store music, it's an easy choice.

Dropbox Smart Sync

If you're a Dropbox user and have multiple Macs or are sharing folders from other people, you might have many gigabytes of files on a laptop that don't need to be there. The service's Smart Sync feature, added to all its paid plans in May 2019, lets you choose which files are stored locally and which are available via the Dropbox cloud. Right-click any file or folder in your Dropbox folder, choose the Smart Sync item, and choose Online Only. Unlike iCloud Drive, Dropbox immediately removes synced files, freeing up space. But like iCloud Drive, those files remain in the Dropbox folder, and will be downloaded automatically when you open them.

None of these strategies except Dropbox Smart Sync deletes files locally except when storage space becomes full and there's no way to force deletion without removing the actual items. If you have plenty of storage left on the Mac you're migrating from, you might try the bizarre trick of making a large empty file and then duplicating it to start filling storage. macOS will notice storage getting cramped and start removing local, synced files that are stored in iCloud in one of the above forms.

To create this file, launch Applications ➔